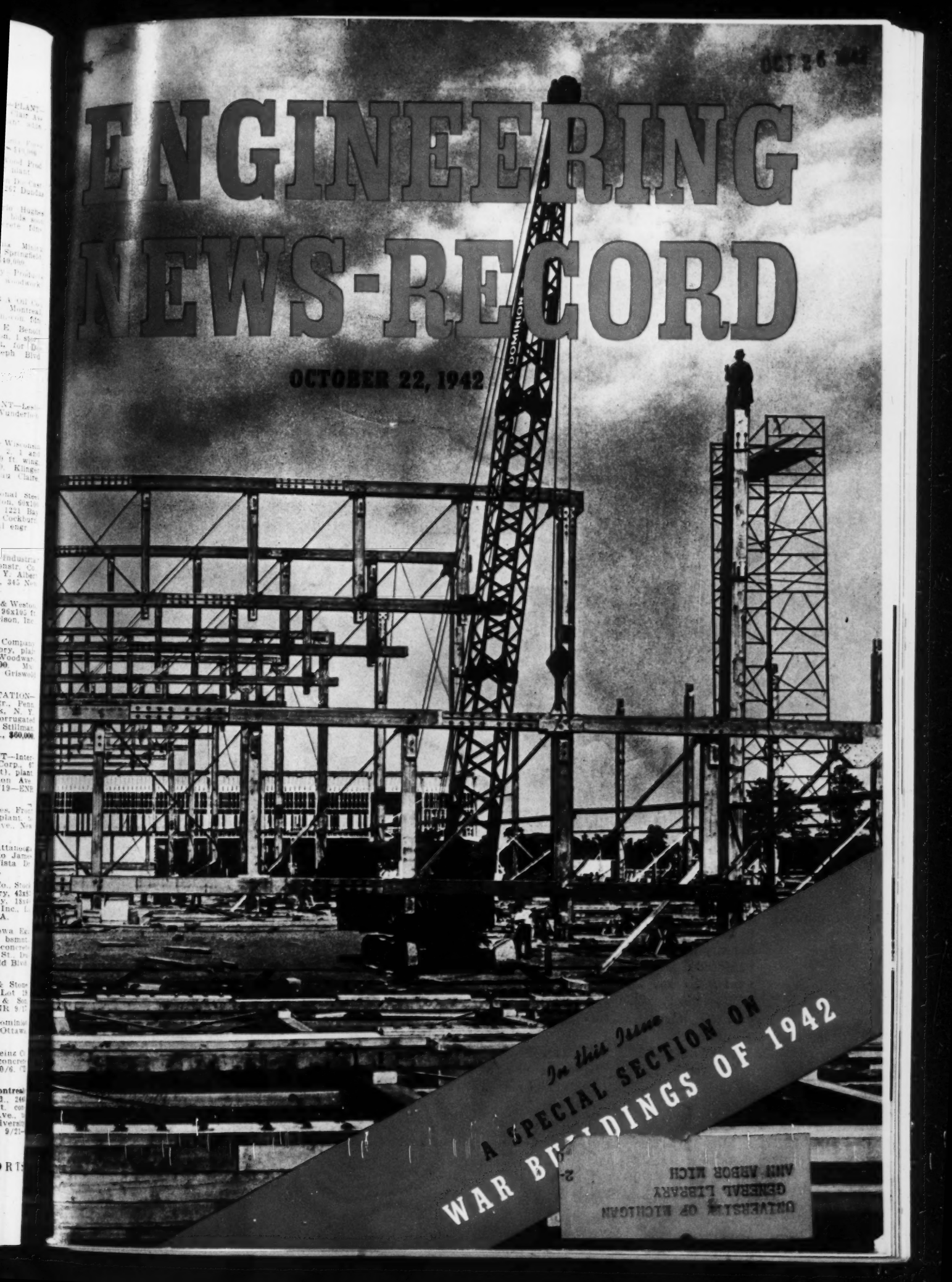

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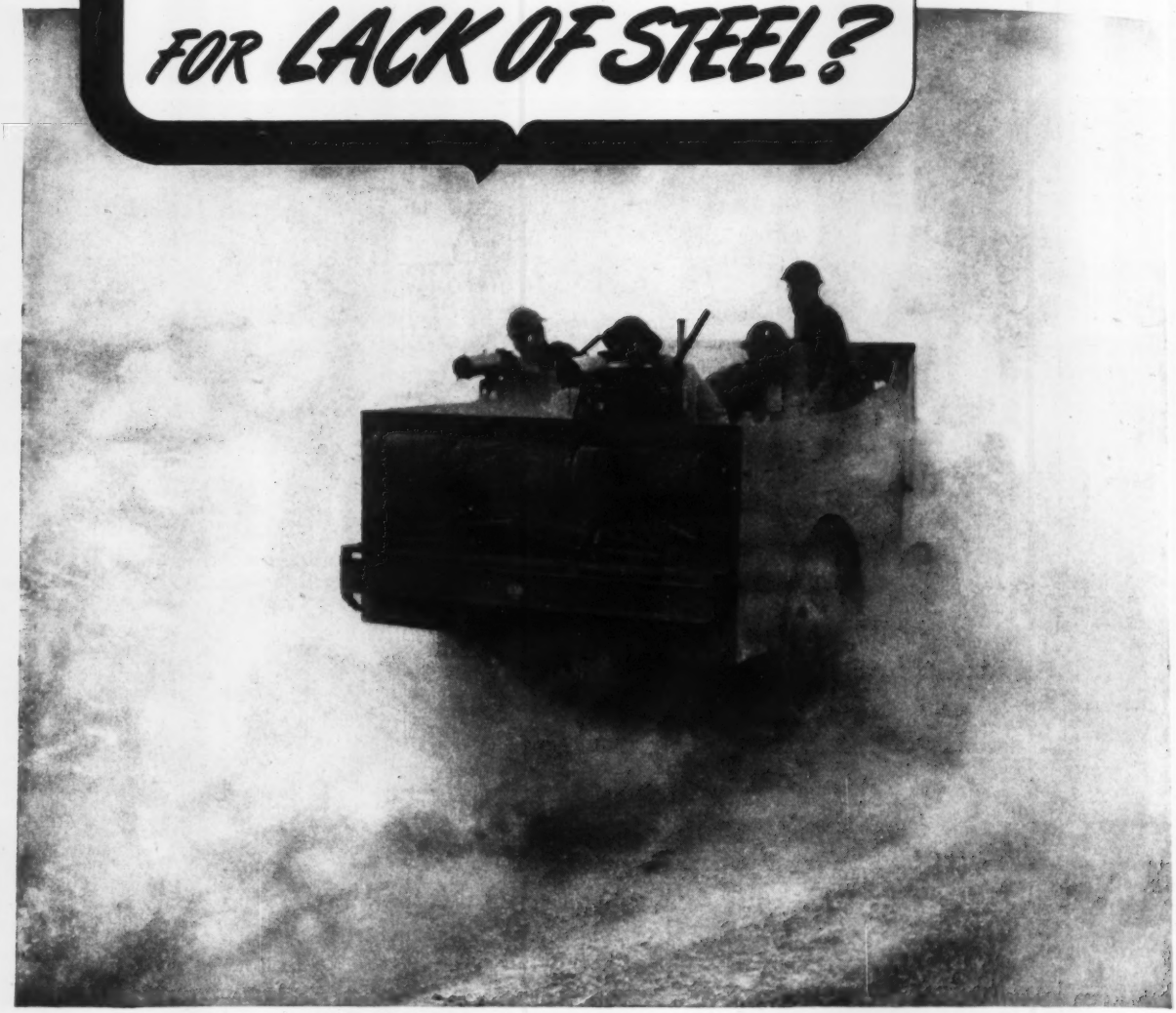
WILL OUR MEN LOSE BATTLES FOR LACK OF STEEL?



WAR *IS* HELL! Yet this war could be worse than hell. Crucial battles will be lost and needless thousands of lives sacrificed unless our fighting men get all the equipment they need.

LET'S LOOK AT THE FIGURES: Most of this equipment is largely made of steel. Our steel industry made sixty-seven million tons in 1940. It produced eighty-three million tons in 1941. *Yet we need still more.* This year the steel industry *can* produce ninety million tons if you and other Americans will *gather up* and *turn in* six million *additional* tons of scrap.

WHY SCRAP IS NEEDED: New steel is made from scrap iron and pig iron—about half and half. Because the scrap has already been refined it cuts down priceless production time.

WHAT CAN *YOU* DO? Plenty! Gather up all worn-out or obsolete tools, equipment and other useless materials. Urge your associates to do the same. Then call the scrap dealer. He'll hurry it off to the steel mills. All scrap will be purchased by the steel industry at government-controlled prices.

BACK UP OUR FIGHTING MEN: The least you can do for our fighting men, perhaps one close to you, is give them the equipment they *must* have. Every minute is precious. Get in the scrap—fast. Armco Drainage Products Assn., Middletown, Ohio.

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This advertisement is in support of the Salvage Program of the Conservation Division of the War Production Board.

ENGINEERING NEWS-RECORD

Devoted to Buildings, Sewers, Waterworks, Bridges, Roads, Dams, Foundations, Earthwork, Flood Control, Public Works, Shipbuilding, Irrigation, Canals, Railroads

McGRAW-HILL PUBLISHING COMPANY, INC.

Publication Office: 99-129 North Broadway, Albany, N. Y. • Editorial and Executive Offices: 330 West 42nd Street, New York

JOHN ABBINK, *Publisher*

WALDO G. BOWMAN, *Editor* ALBERT E. PAXTON, *Manager*

Vol. 129 OCTOBER 22, 1942 No. 17

COMING NEXT

• Fighting Snow to Keep 'Em Flying—An analytical study of the best methods yet devised for the removal of snow from flying fields. Tested procedure in the use of plows, rotary blower units, high speed trucks, other equipment, and problems of maintenance are discussed at length. Fields for both wheel and ski landings, and Canadian methods of compaction are described.

• How water leakage through 600,000 sq. ft. of exterior brick wall surface was stopped is the subject of an interesting and timely article. This data is especially valuable at this time when so many old warehouses are being converted for storage of war equipment and supplies.

• A method for preparing an isometric grade chart for use in selecting grade for an airfield is described. This procedure reduces computations to a minimum and adjustments to save excavation can be made largely on the basis of visible inspection of the chart. Field methods for laying out runway intersections by the same system are given.

LOOKING AHEAD

• To provide adequate pavement markings for traffic control under blackout conditions, yet keep the cost within reason, is proving a headache for municipal and highway traffic engineers. Glass-beaded paint, however, is proving a happy solution. Although costing nearly twice as much as ordinary traffic paint it wears four or five times as long by actual test. How the city of Philadelphia is using this product in a 500 mi. pavement marking program will be told in the Nov. 19, issue.

• With the vast amount of timber now being used in building construction to save vital steel it becomes increasingly important also to conserve our timber supply. In "Designing Rigid Frames of Timber," a thought provoking article to appear in an early issue, the author discusses possible savings in lumber by a wider use of rigid frames. Tables to permit rapid design are included.

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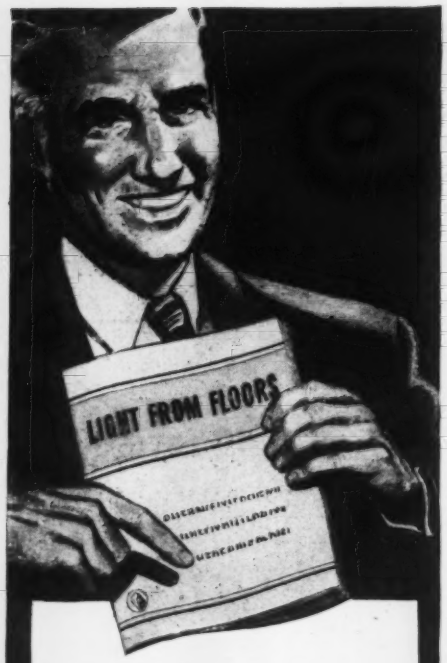
Number of copies of this issue printed: 37,866



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ENR-F-5

The Week In Engineering and Construction

ENGINEERING NEWS-RECORD • OCTOBER 22, 1942 • VOLUME 129 • NUMBER 17

Push use of existing housing as shortages cramp building

National Housing Agency advances scheme for remodeling homes and vacant buildings to house war workers as lumber shortage threatens general program

With hope largely disappearing that it will ever be able to carry out the full 205,000-unit housing program for which money is provided in pending legislation (*ENR*, Oct. 1, p. 449), the National Housing Agency is turning its attention toward a program of re-modeling existing structures into apartments suitable for war workers. Completion of Congressional action on the housing appropriation is expected within a few days, though it's not yet certain whether the amount will be $500,000,000 or $600,000,000.

Money is not the main difficulty; it's material shortages.

Curiously, too, it is not the scarce metals that are causing the trouble. High priority ratings of AA-2 and AA-3, made available under the recent WPB allotment granting approval of materials for the pending housing program, are making it possible to get the scarce materials.

The trouble lies in obtaining the needed lumber. Lumber has become nearly impossible to get for housing in many areas, and there is little prospect that this situation will change (*ENR*, Oct. 8, p. 463).

NHA is trying to overcome the difficulty by redesigning its houses, emphasizing brick masonry and concrete rather than wood. But chief reliance to meet the estimated need for more than a million dwelling units for war workers in the coming year is being placed on conversion of existing structures.

This conversion program has two parts. Under one scheme the Federal Public Housing Authority will buy large abandoned buildings—warehouses, old hotels, and the like—and remodel them into apartments for war workers.

To handle the second part of the program, a new unit is being set up in the NHA—the Homes Use Division. HUD will rent existing houses, on a voluntary basis, from the present owners. It will remodel them into apartments at government expense and rent them to workers. After the war the houses will be returned to the owners.

NHA is relying on these two programs—plus similar projects carried out privately—to provide something like 850,000 units during the coming year. So far, voluntary action has been depended upon to supply these needed existing structures, but there's little doubt that a certain amount of requisitioning of houses will ultimately be necessary.

Rhode Island city cited as priorities violator

The City of Pawtucket, R. I., has been added to the War Production Board's list of violators of priorities regulations, after it had erected an $8,500 steel chain link fence around a baseball field at the new municipal stadium.

City officials were ordered by WPB to remove and hold the fence for sale only to the Army or Navy. The fence was built after June 8.

WPB suspension order S-112, directing the removal, said that under the agency's order L-41-a, issued May 23, all construction primarily for the amusement of the public, costing in excess of $5,000 and excepting strictly temporary work and playgrounds for children, must halt by June 6. WPB's compliance division holds that a baseball field with a large grand-stand and bleachers cannot be considered to fall within the excepted types of construction.

Wide World photo

Normandie salvage operations continue

Huge cranes, barges and other salvage equipment are shown alongside the stripped-down main deck of the capsized former French Line steamship "Normandie" renamed the "Lafayette" when taken over by the United States Government.

Shortly after the 83,000-ton vessel burned and capsized at its dock in New York, a special committee working with the Navy Department recommended controlled pumping as the most practical salvage method (ENR, May 28, p. 880).

Workers above are shown aiding a diver, whose helmet may be seen entering the water at lower left, going down into the submerged port of the ship's port side to seal openings and clear away debris preparatory to the pumping operation.

Heavy rains bring near-record floods in three states and nation's capital

Virginia hardest hit as rain in Shenandoah watershed tops record, James River Bridge damaged. Potomac rises above 1936 stages.

Floods last week in Washington, D. C., Virginia, Maryland and West Virginia represented a combination of a record breaking flood on the Shenandoah River in Virginia, the peak of which was synchronized with a moderate flood on the upper Potomac in Maryland and West Virginia. The combination produced a deluge at Washington of just about the same proportions as the record flood of 1936.

Official comparisons are not yet available, but it is clear that rainfall on the Shenandoah approached or exceeded all-time records, according to preliminary figures released by the U. S. Weather Bureau.

The Athens, Va., station at the headwaters of the Shenandoah recorded 10.51 in. of rainfall in the four days from the morning of Oct. 13 to the morning of Oct. 17. Farther down the Shenandoah, at Riverton, a rainfall of 16.81 in. was recorded; this was near the point of greatest rainfall in the storm.

As a result of these heavy rainfalls, the river reached a stage at Riverton of about 50 ft. above mean low water, as compared with 37.5 ft. in 1936.

On the upper reaches of the Potomac, rainfall was considerably less. Greatest was at Glencoe, 8.23 in. for the four day period. At other stations it ranged from 6 to 7 in. Relatively moderate flood stages were recorded on the upper Potomac—24.3 ft. at Cumberland as compared with 29.1 ft. in 1936, and, farther downstream, 36.6 ft. at Hancock where 47.6 ft. was recorded in 1936.

At Harpers Ferry, however, just below the junction of the Shenandoah and the Potomac, a near record stage of 37.5 ft. was recorded as compared with 36.5 in 1936. Heavy rainfalls on the Monocacy River, which joins the Potomac below Harpers Ferry, further increased the stages of the lower Potomac. At Sycamore Island, just above Washington, the stage of 26.8 ft. was even closer to the 1936 record of 28.1 ft. A few miles downstream, in Washington itself, the 1936 record of 17.2 ft. was actually surpassed with a stage of 17.56 ft. This was probably due to construction work in the river.

Virginia damage

Damage to the Virginia highway system was estimated at a million dollars by C. S. Mullen, chief engineer of the Virginia State Department of Highways.

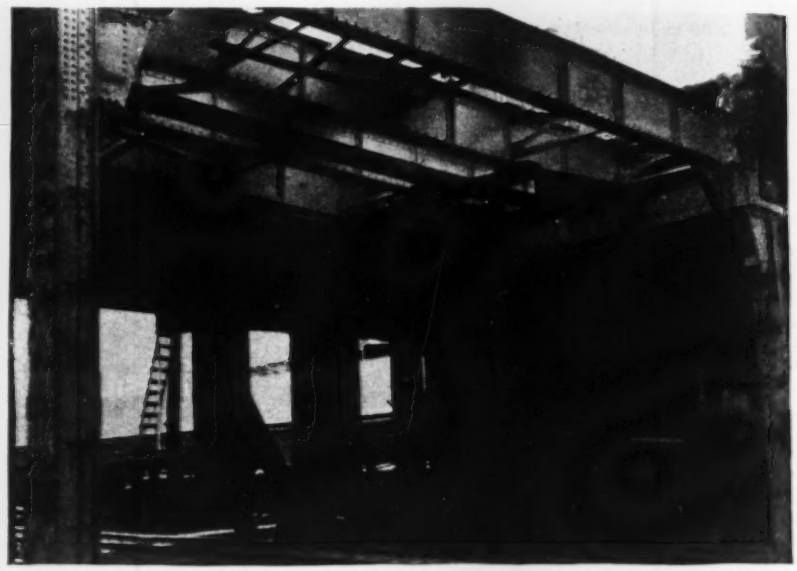
At Winchester, weather bureau reports showed a total of 15.41 in. in four days, including a high of 6.51 in. on the second day. Other rainfalls reported included: Fredericksburg, 12.57; Clarendon, 6.77; Charlottesville, 6.20; Lynchburg, 5.11; and Richmond, 3.07.

Major damage to the highways was on the shoulders, at small bridges and bridge approaches. Numerous railroads in the area southwest of Washington had property damage. Traffic on the Richmond, Fredericksburg and Potomac roads between Washington and Richmond was halted for 18 hours during the night.

Major damage on the Chesapeake and Ohio Railroad was the loss of two spans and one pier of a three-span plate girder bridge over the James River at Howardsville, Va. A temporary bridge was constructed by Sunday morning. All lines were in service Monday. The Pennsylvania Railroad bridge over the Potomac at Washington was closed to traffic Friday night at the crest of the flood on that stream, but the interruption was short as service was resumed over the crossing Saturday morning.

Fredericksburg, Va., on the Rappahannock River, seemed to be the hardest hit by the flood. The city's water supply system was put out of service for several days and electric service was interrupted for two days. In Maryland, the city of Cumberland found its downtown streets under 3½ ft. of water, but other damage was not apparently great. However, in many of the small riverside towns in Maryland, the damage was large.

Storage in the Wanaque reservoir, chief reservoir for the North Jersey District water supply, is at its highest point for the year, and considerably above its level at this time last year, according to Charles E. Capen, chief engineer.



Repair viaduct damaged by high load on freight car

Repairs were completed recently on the 21st St. viaduct, a reinforced concrete structure in Birmingham, Ala., damaged when a carload of structural steel on a railroad track below failed to clear.

Damage was confined to four of nine concrete stringer beams in one opening between two concrete cross girders. To replace these four beams, engineers decided upon a steel superstructure, consisting of four beams, carried by a cross girder supported on new steel columns. While the steel superstructure of the renewed section does not tie in directly with the main body of the viaduct, the reinforcing bars and concrete slab on top furnish the desired connection.

The new steel columns extend about 4 ft. underground, and are supported by concrete pedestals which extend down to bedrock, a distance of about 20 ft. from ground level. The columns had to be in line with the concrete columns so as not to cut down the lateral clearance, and new cross girders were supported on brackets as shown in illustration. All exposed steel was covered with air-applied concrete.

Work was done by the Louisville & Nashville Railroad, with R. M. Leeds, division engineer, in general charge and O. O. Wilhite supervisor of bridges and buildings, and J. U. Estes in direct charge. Trains moved without interfering during the operation and automobile traffic also continued to use the viaduct, only the damaged section being blocked off.

OPA clarifies construction equipment rental and operation charge ceilings

Amendment to original price order simplifies procedures in ordinary construction practice, increases rental rates on power shovels.

Regulation of the charges for rental, operation, and maintenance of construction and road machinery was simplified this week with the issuance of an amended version of Price Regulation 134, which formerly established definite charges for rental of equipment.

Particularly simplified is the common transaction in which a machine is rented with an operator, fuel, lubricants, and all repairs provided by the owner of the machine. Previously, this transaction was covered by three different price regulations—the rental of the bare machine by Regulation 134, furnishing of operating supplies and repair parts by the General Maximum Price Regulation which froze prices as of last March, and repair and operating services by Regulation 136—machinery services.

Under the amended Regulation 134, rental of the bare machine is still fixed in dollars and cents. Price of any additional services, parts, or supplies furnished in connection with the rental (or similar services on contractor-owned equipment) is frozen at the charge regularly made by the supplier on March 31. If there was then no regular charge, a price is to be computed in accordance with the formula which would have been used on that date, using labor and material prices then in effect.

Other changes in the regulation increase the rental rates for power shovels by about 10 percent and for concrete finishing machinery by about 25 percent. Rates for compressors are reduced about 20 percent. Prices are established for several additional types of equipment, including: air receivers, backfillers, suction hose, finegraders, belt loaders, bituminous mixers, and pipelayers.

• • •

Railroad company to sell 20 steel bridges

Offering a possible partial solution to highway departments in their frantic search for material to replace old bridges or those damaged by storms or other cause, the International Railway Co., of Buffalo, N. Y., has offered 20 steel bridges for sale.

The bridges are now located on the company's high speed right-of-way between Buffalo and Niagara Falls, N. Y.

The structures were manufactured by the American Bridge Co. in 1916 and 1917, and erected in place during those same years by the Pittsburgh Construction Co. They are said to be adaptable to maximum highway loadings now in use and to be in excellent condition, with no significant corrosion.

According to railway company officials, the bridges have never been called upon to carry anywhere near the maximum loading for which they were designed, and consequently have never been overstressed. They are so located that upon dismantling they can be readily trucked to railroad loading points.

To be sold are 14 through girder bridges with spans ranging from 56 to 111 ft.; two deck girder bridges of 38 ft. and 59 ft.; and four through riveted truss spans ranging from 142 ft. to 176 ft.

New Seabee training center nears completion

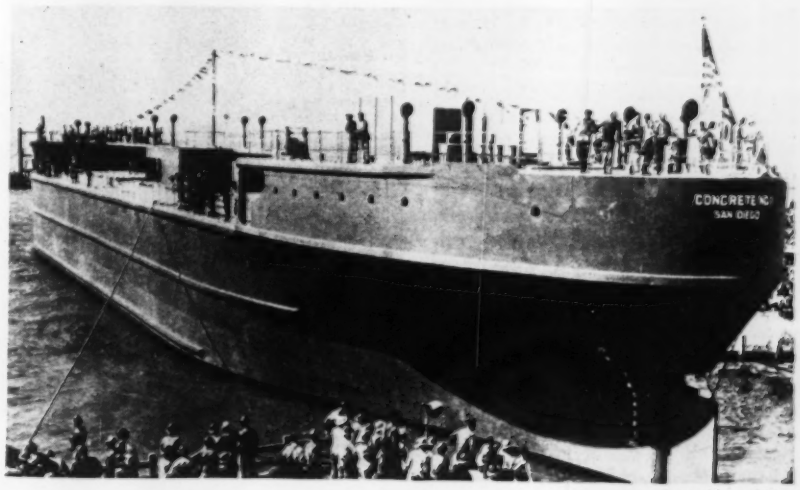
Camp Peary, a new training center for the "Seabees"—Navy Construction Battalions—near Yorktown, Va., will be ready to receive its first battalion early in November.

The camp is named for the late Admiral Robert E. Peary, discoverer of the North Pole, who was an officer of the Navy's Civil Engineer Corps.

The new station will consolidate all activities of the rapidly growing organization now training in two camps, Allen and Bradford, near Norfolk, Va. (*ENR*, Sept. 24, p. 415).

When completed, Camp Peary will handle a new battalion every three days, and will accommodate ten battalions in detention and ten in advance training in addition to a ship's company complement of 5,000 men.

The camp will consist of tar-paper barracks, 20x100 ft., to house 60 men each.



Acme Newspictures

First concrete barge takes to the water

"Concrete No. 1" is the prosaic name of the first reinforced concrete vessel built in the United States in 22 years, which was launched successfully, Oct. 13, at the Southern California yard of Concrete Ship Constructors, Inc., a firm formed by two well-known contractors, Tavares Construction Co. and Elliott, Stroud & Seabrook. Although shaped like a ship, "Concrete No. 1" is a barge, designed to be towed, and is the first of a large number being built for the Maritime Commission in special yards on the Atlantic, Gulf and Pacific coasts (ENR Sept. 4, 1941, p. 319 and Nov. 3, 1941, p. 693). Some self-propelled concrete ships are also being constructed under a more recent order (ENR June 18, 1942, p. 970).

The barges have a capacity for 50,000 barrels of liquid. They are 375 ft. long, of 56-ft. beam, draw 38 ft. of water, and have a displacement of 14,000 tons.

"Concrete No. 1" required 5½ months from keel laying to launching, but succeeding vessels will be built in 2½ months, now that production kinks have been worked out. The construction procedure used by Concrete Ship Constructors involved shore prefabrication of the exterior forms in large sections, resembling those sections prefabricated in steel for the Liberty ships. Moved to construction basins by cranes, the sections were assembled into the outline of the ship. Reinforcing steel was then fastened in place for hull and bulkheads, and concrete pouring begun, inside forms being added progressively in 18-in. lifts. The 3,000 cu. yd. of concrete was placed by buggies in three pours, the first of 1,300 yd. to 9 ft. above the bilge, the second of 700 yd. to 4 ft. below the deck, and the third of 1,000 yd. completing the hull and the deck.

Launching of the vessel consisted merely in letting water into the construction basin and floating it to a nearby fitting-up pier, where the deckhouse will be poured and other finishing touches put on.

Manpower discussed at joint meeting of American and Canadian engineers

Joint meeting of the American Society of Civil Engineers and the Engineering Institute of Canada at Niagara Falls, Ont. considers questions of manpower for military and civil needs.

Questions of manpower to meet military and civilian needs, training of engineers for army service, and training of young engineers during the war period occupied the center of interest at a joint meeting of the American Society of Civil Engineers and the Engineering Institute of Canada held at Niagara Falls, Ontario, Oct. 14-15. Five divisions of the A.S.C.E. held meetings during the second day, subjects for discussion being closely related to the war in most instances.

Ezra B. Whitman, consulting engineer, Baltimore, was named as the official candidate for president of the American Society of Civil Engineers at the fall meeting of the board of direction held on Oct. 12. The board also elected to honorary membership in the society the following men: Alonzo J. Hammond, consulting engineer, Chicago; Lawrence M. Lawson, American Commissioner, International Boundary Commission, El Paso; Rear Admiral Ben Moreell, Chief of the Bureau of Yards and Docks, U. S. Navy; Lieut. General Brehon B. Somervell, commanding general, Services of Supply, U. S. Army; and Sherman M. Woodward, chief water control planning engineer of the Tennessee Valley Authority. Award of certificates of honorary membership will be made at the annual meeting in January.

Two meetings cancelled

The board of direction voted to cancel the spring and fall meetings of the society in 1943 due to war conditions. The annual convention will be held in midsummer, the place to be decided at the January meeting of the board.

The committee on the Tacoma Narrows Bridge submitted its report to the board of direction at the Niagara Falls meeting. The committee found that "the methods of design computation, which had proved satisfactory on structures of other proportions, were not satisfactory for designing a structure of the proportions used in the Tacoma Narrows Bridge." It also found that "the methods used in attempting to reduce the oscillations which were found to occur after the completion of the bridge were not effective although they perhaps delayed destruction of the bridge."

Manpower control

Highlights of how Canada is exercising war-time control over manpower, was given at the opening session of the joint meeting by L. Austin Wright, secretary of the Engineering Institute of Canada, and assistant to the director of the National Selective Service, and H. W. Lea, chief of the Wartime Bureau of Technical Personnel. Much of Mr. Wright's talk centered on the functioning of the latter bureau, in which control over engineers is centered, as reported in ENR Oct. 8, p. 489.

Details of how National Selective Service affects general construction were given by Mr. Lea. No employee can be dismissed without a 7-day notice, and none may quit without giving his employer a 7-day notice. No man may seek employment without an N.S.S. permit, which permit clearly states his trade and his qualifications, such as carpenter or carpenter's helper, so that no man can represent his skill to be above that of his actual qualifications. Permits are limited to specific areas, thus keeping men from losing time by shifting around the country.

Greystone Studios

Ezra B. Whitman, senior member of the Baltimore consulting engineering firm of Whitman, Requardt & Smith, and chairman of the Maryland State Roads Commission, nominated for president of the American Society of Civil Engineers.

Advertising for help is prohibited except on special authorization from the National Selective Service. Firms requiring men have to file their requirements with the service and firms releasing men must notify the service in advance of their release.

Mr. Lea said that their chief difficulty so far has been with contractors who try to sidestep the control requirements set up by the National Selective Service. No difficulties have developed with labor unions, but when questions from the floor as to how such matters as maintenance of membership clauses were handled when men were shifted around, or what was done about closed shop agreements, Mr. Lea stated that these issues have not yet been raised.

The engineer's place

An inspiring talk on the place of the engineer was made at the Wednesday luncheon meeting by Dean C. J. Young of the University of Toronto, president of the Engineering Institute of Canada. The principle of trusteeship, said Dean Young, is fundamental to the engineering profession. If it is discarded, engineering ceases to be a profession and becomes simply a trade. This principle is frequently overlooked where engineers occupy positions as employees, but according to Dean Young, it is as fundamental to their employment as it is in the case of an engineer engaged on a fee basis. He emphasized the desirability of looking beyond purely engineering considerations to see also what human factors are involved.

Civilian protection

A closed session on civilian protection was held Wednesday afternoon at which engineers from the two countries exchanged experiences in developing protective measures. Summaries of the confidential lectures to Canadian engineers by Professor F. Webster, deputy chief engineer of the British Ministry of Home Security, were given by Harry F. Bennett, district engineer of the Department of Public Works, and a summary of the work of the committee on engineering features of civil defense of the Engineering Institute of Canada, was given by Robert F. Leggett, associate professor of civil engineering, at the University of Toronto. Experiences of the A.S.C.E. committee on civilian protection were presented by Ernest P. Goodrich, its chairman. Various aspects of the problem were discussed by John I. Parcel, consulting engineer, St. Louis, Professor Harold E. Wessman, New York University, and Major J. P. Carriere of the Canadian Engineer Corps. Major Carriere, summed up the discussion in saying that man's capacity for destruction has exceeded his capacity for construction, and that as a consequence, our chief means for protection against bombing now lie in dispersion of the population within areas subject to attack rather than in structures designed to stand up under such attack.

Niagara control weir

The power division gave its attention to plans for remedial works above the cataract at Niagara Falls. The major element of this project, a submerged weir near the head of the rapids on the Canadian side of the river, now is under construction.

A. S. C. E. honors five members

Five members of the American Society of Civil Engineers were elected to honorary membership in the society by the board of direction at its fall meeting. They are:

Alonzo J. Hammond, Consulting Engineer, Chicago.

Lawrence M. Lawson, American Commissioner, International Boundary Commission, El Paso, Texas.

Rear Admiral Ben Moreell, Chief, Bureau of Yards & Docks, U. S. Navy.

Lieut. Gen. Brehon B. Somervell, Commanding General, Services of Supply, U. S. Army.

Sherman M. Woodward, Chief Water Control Planning Engineer, Tennessee Valley Authority, Knoxville, Tenn.

Problems to be met and the studies that led up to the work now in hand were reviewed by Norman Marr, chief hydraulic engineer, Dominion Water & Power Bureau, and the hydraulic aspects of the undertaking were discussed by C. G. Cline, senior assistant engineer of the bureau and E. B. Strowger, chief hydraulic engineer of the Niagara Falls Power Co.

The hydraulic problems are many and so involved that it is not planned to complete the weir until its full effects have been studied over many months.

Originally, the remedial works were proposed chiefly to redistribute the flow over the Falls so that the scenic effect would be improved and erosion at the center of the Horseshoe Falls checked, at the same time permitting increased power diversion to be studied. Now, however, interest centers chiefly in power as every available power unit, regardless of its efficiency, is being used to meet the needs of the Niagara region. A rise of 1 ft. in the Chippewa-Grass Island pool above the cataract from which water for power is drawn, will add 30,000 hp. to the output of the plant by increasing the head and enlarging the carrying capacity of the intake canal. Hence the work on the main weir is being undertaken as a war measure. Work on lesser weirs to redistribute the flow near the cataract will not be undertaken until after the war.

Construction of the weir was described by Major H. C. Woods of the U. S. Engineer Office at Buffalo, and by David Forgan, construction engineer of the Hydro-Electric Power Commission of Ontario. The weir is being built from an artificial island above Goat Island, extending across the channel to near the Canadian shore. It was planned to build the weir by means of a steel trestle built out from the Canadian shore as the work progressed. (*ENR* Feb. 14, 1929, p. 281). Scarcity of steel made that plan impossible at the present time, hence the work is being done with the cableway that was used to build Conchas and Dennison dams. Details of the construction are to be given in a subsequent issue of *Engineering News-Record*.

The weir is being built of loose stone, 40 ft. wide on top and with its crest 6½ ft. below water level. The cableway is to be left in place for some years so that the elevation of the top can be raised or the length changed if that is found desirable.

Army engineer training

Present methods for training engineer troops and officers for the Corps of Engineers were described at the Thursday luncheon meeting by Brig. Gen. Edwin H. Marks, commanding officer at Fort Belvoir. General Marks said that preinduction training soon is to be inaugurated which will cut the time required in the training courses at Fort Belvoir. Enlisted men now get 12 weeks, and those who show aptitude for leadership and have some engineering background are sent to the officer's candidates school where they get 12 more weeks of intensive training. This route now is the principal source of young officers supply. Engineers from civil life, General Marks said, get an intensive six weeks training before being commissioned as officers.

Flight strips

What is being done by federal agencies in the matter of building flight strips was reported to the highway division meeting in general terms by Fred E. Schnepfe, director of the flight strip division of the Public Roads Administration. Congress has appropriated $10,000,000 for this work. Regional heads of the Air Force Command specify the general areas in which flight strips are needed, after which the engineers of the PRA and of the state highway departments select the most suitable sites in those areas. Sites thus selected are reported to the Air Force Command, and when approved, actual construction of the strips is undertaken by the highway departments in the states where they are located.

Wheel loads on these flight strips are higher than those on the highways, Mr. Schnepfe said, but as the frequency of repetition of loading is much less, fatigue is not considered in the design.

In discussion, this policy was questioned by Lt. Col. H. M. Hill who said that tests on bituminous and concrete pavements made by the Army engineers, using loads comparable to plane loads, have resulted in the failures under as few as 500 repetitions. Loads used were 30,000 lb. on concrete pavements having an 8-6-8-in. section. Surprise at this statement was expressed by L. E. Andrews, regional highway engineer of the Portland Cement Association, New York, as an 8-6-8-in. section is considered a fairly heavy concrete pavement.

W. L. Malcolm, director of the school of engineering at Cornell University, asked whether American engineers had been informed as to British experience with runways for heavy bombers. In partial answer to that question, Major J. P. Carriere said that the British were using 8 to 9 in. of grouted crushed stone over a compacted sub-base.

Highway pavements

The second paper was one by Mr. Andrews on "Wartime Concrete Pavement Design." Observing that steel as now used in concrete pavements is not put there to add load carrying capacity

(*Continued on following page*)

A.S.C.E. sections discuss war problems

Representatives of about twenty local sections of the American Society of Civil Engineers from Central and North Atlantic states met at Niagara Falls, Ont., for an all-day conference the day before the fall meeting of the society met in that city.

As at previous local section conferences this year, much of the time was given over ot discussion of civilian protection activities of the local groups, the discussion being led by E. P. Goodrich, chairman of the society's committee on civilian protection. Considerable time also was given to discussion of wage and working conditions with Howard Peckworth, field man for the societys' committee on employment conditions.

The conference concluded with a discussion of local section activities under war conditions. In opening the discussion, George T. Seabury, secretary of the society, said that the society faced a considerable reduction in income next year due to the large number of men in military service.

Several speakers told of difficulties in getting speakers who could find time to prepare papers. At Providence so many members are in war service that the section officers doubt that they can hold enough meetings to qualify for an allotment from the parent society. G. A. Hathaway of the District of Columbia Section expressed the opinion that the parent society should curtail its main meetings rather than force sections to curtail their activities by reducing allotments to the sections.

but only to hold cracked pavement sections closely together and to provide load-transfer from section to section, Mr. Andrews said that steel can be eliminated if enough expansion joints are provided to minimize cracking and if cracks can be concentrated at points where incompressible material can be kept out of them. This is done by forming dummy joints at fairly close intervals, the tops of these joints being filled with bituminous materials.

Most of the Northeastern states now are using unreinforced concrete pavements in which the spacing of expansion joints averages 120 ft. apart and dummy joint spacing ranges from 15 to 30 ft., averaging 20 ft. Some highway departments are experimenting with expansion joints spaced as far apart as 500 to 600 ft.

Load-transfer dowels at expansion joints can be eliminated by thickening the end of the slab at expansion joints and at construction joints. The thickening should be carried back on a flat slope for about 5 ft. Use of subslabs 4 to 6 in. thick and 4 to 5 ft. wide under slab ends is another way to eliminate dowels. These methods cost more than dowels but conserves steel.

Elmer Lawton, district engineer, New York State Highway Department, Syracuse, expressed himself as favoring the use of dowels if they can be obtained.

Conservation of materials

The structural division centered much of its attention on conservation of critical materials and the related question of the design of timber structures used to conserve steel. In opening the discussion, Lt. Col. H. M. Hill of the office of the Chief Engineers, U. S. Army, laid stress on the fact that while some materials are more critical than others, all materials must be conserved in these days. Three ways in which to conserve material, Col. Hill said, are as follows:

(1) Avoid their use altogether by better planning, by use of existing buildings, or by conversion of old facilities to war use.

(2) Substitution of less scarce materials for those in which serious shortages exist.

(3) Modification of existing standards such as the lowering of factors of safety in design by the use of higher working stresses.

Moving a coal bridge

Methods employed in moving a 475-ton coal bridge to a new location at the Algoma Steel Co. plant at Sault Ste. Marie, Ont., were described by David C. Tennant, of the Dominion Bridge Co., before the structural division. The bridge has four legs and a span center-to-center of rails of 300 ft. Derrick booms were inserted as knee braces in the legs and 1½-in. tie rods were put in between each pair of tower legs, then the legs were jacked up and placed on standard railroad car trucks, for the movement over tracks laid for that purpose.

Timber structures

A timber bowstring arch is from 10 to 15 percent more economical than a parallel-chord timber truss, according to Verne L. Ketchum, chief engineer of Timber Structures, Inc., Portland, Ore. Laminated beams of 70-ft. span now are being built, he said, and trusses up to 200-ft. span. In discussion, F. J. Hanrahan, National Lumber Manufacturers Association, said that spans of 325 ft. now are being designed.

Problems that the timber committee of the structural division expect to study were reported to the division meeting at the close of the session by Prof. H. J. Hansen, chairman of the committee. These include continuity over joints, use of connectors in design, and radial stresses in curved members.

Employer-employee relations

Eminently successful employer-employee relations have been developed in the construction industry in the Niagara Falls region, according to C. W. Wright, president, Wright & Kremers, Niagara Falls, N. Y., speaking before the Construction Division. Difficulties, Mr. Wright said, are caused chiefly by small operators and speculative builders who do not take a long-time view of the advantages to be gained by good labor relations. Another source of trouble has been attempts by CIO to unionize construction in the Niagara Falls region.

D. B. Chant, National Selective Service, told the construction division of how Canada is expanding its labor forces to meet war needs. The major steps are (1) extension of the use of women in industry; (2) transfer of men from non-essential industry (such as from gold mining to nickel mining); (3) use of available manpower at greater efficiency. To obtain the latter objective, the National Selective Service is giving very close attention to industrial relations. Whenever possible, joint management-labor committees are being set up in Canadian industries, but always on a voluntary basis.

Unusual concrete framing

Concrete frames of unusual design which were selected for a transit shed now being built on one of the new piers at St. John, N. B., were described to the Construction Division by Frank E. Sterns. The piers were built in the years 1937-38. (*ENR* Feb. 15, 1934, p. 219) and two of three proposed transit sheds were built at that time. No steel being available for the third shed, both wood and reinforced concrete designs were studied, but the latter material was selected because it showed a slight saving over timber framing. Tied arches of reinforced concrete are to be used, supported on concrete columns whose reinforcing is to be welded to bolts set in the deck as anchors for steel shed columns when the pier was built.

The reinforcing is to have a cover of 2 in. due to the exposed location and as a precaution against injury due to fire. Purlins are to be of precast concrete, and the roof will be of laminated timber surfaced with tar and gravel. Tie rods for the arches are to be heated to prestress them, thus reducing bending moments in the column.

Border surveys

Surveying along the Niagara Frontier was the subject of a paper by William A. Rathmann, consulting engineer, Buffalo, before the surveying and mapping division. At the same session, Frederic H. Peters, chief of the Canadian Hydrographic Service, outlined surveying and mapping methods employed in Canadian government works.

Submit simplified wire rope specifications

A proposed simplified practice recommendation for wire rope has been submitted to producers, distributors, users and others interested for approval or comment by the division of simplified practice, National Bureau of Standards.

The recommendation is designed to conserve strategic materials and available production capacity.

General adherence to twenty tables accompanying the recommendation will cut variety from 973 items to 643. The major production and use of wire rope, is covered by four different rope-constructions, where the reduction in variety is from 352 items to 182.

Mimeographed copies of the proposed recommendation are available at the bureau offices, Washington, D. C.

Bolt shortage to [illegible] part of N. Y. tunn[illegible] work

Work on the Brooklyn [illegible] of New York's Brooklyn-Battery [illegible] under the East River must be [illegible] due to War Production [illegible] to grant priority on $50,0[illegible] worth of cast steel bolts needed to [illegible] segments, Mayor LaGuar[illegible] has announced.

However, tunneling th[illegible] solid rock on the Manhattan end [illegible] the project will continue, the Mayo[illegible] said.

In refusing priority, WPB said it felt the tunnel was too remote fr[illegible] the war effort to warrant further [illegible] of vital materials. The agency did, however, indicate it would give favorable action on $5,000 worth of smaller bolts needed to seal the Brooklyn end against undue seepage.

OBITUARY

Theodore Ernest Schnitzler, 52, consulting engineer of Milwaukee, died there Oct. 7.

W. J. Alexander, 82, retired former superintendent of the St. Augustine, Fla., waterworks and once city manager of Gastonia, N. C., died at St. Augustine recently.

Prof. Lyall Radcliff McCurdy, 45, a member of the Faculty of Engineering at McGill University, Canada, died at Montreal Oct. 9.

Lieut. Col. Charles W. Burlin, 56, formerly affiliated with the Tampa, Fla., city engineer's office, died recently in Washington, D. C.

Karl L. Ponzer, 56, civil engineer of Elizabethtown, N. C., died there Oct. 15.

Capt. Harry Maynard, 54, recently a member of the engineering staff of the Leathem D. Smith Shipbuilding Co. of Sturgeon Bay, Wis., died at Sturgeon Bay recently.

John Charles Park, civil engineer and contractor of Denver, Colo., died recently.

William M. Galloway, Sr., 62, an employee of the U. S. Engineer Office at Memphis, Tenn., for the past 14 years, died Oct. 11 at Memphis.

James Marion Knox, 79, Huntersville, N. C., a member of the Mecklenburg county drainage commission, died Oct. 13.

Maj. John Hastings Howland, 72, formerly superintendent of public works for Honolulu, T. H., and an expert on fire prevention engineering, died Oct. 11 at New London, N. H.

Frederick D. Woodley, 73, retired builder and contractor, died Oct. 9 at Middletown, N. Y.

Charles W. Buck, Sr., Columbus, Ohio, building contractor, died recently there.

William Thomas Broxton, 82, building contractor of Athens, Ga., died Oct. 11.

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Montana opens bridge

Hailed as of major importance to the communities it serves, a new highway bridge across the Flathead River at Holt, Mont., has been opened to traffic. The bridge is 860 ft. long, was built with WPA assistance, and will save an estimated $3,000 annually in upkeep of a ferry previously operated across the river.

Canada builds Jap evacuation center

Three hundred and eighty homes recently were completed near Hope, British Columbia, to form the new city of Tashme, center created for Japanese removed from the Vancouver district.

The houses are of a prefabricated type, each house containing four rooms, each room allocated to a family. The four rooms open on a central hall which serves as a living room and kitchen for the four tenant families.

In addition to houses, a barn has been fitted up with two terraces of similar type rooms down each side.

Citations presented at engineering school jubilee

At its 50th anniversary last week, the Engineering School of Manhattan College, Riverhead, New York, N. Y., presented honorary degrees of doctor of engineering to three men.

Citations were presented to Emil Hugh Praeger, now a lieutenant commander, USNR, directing the department of design, Bureau of Yards and Docks; Roy Cummings Muir, vice president of the General Electric Co.; and Frederick Henry Zurmuhlen, now chief engineer for the Walsh Construction Co. and the George F. Driscoll Co.

CONTRACTS AND CAPITAL

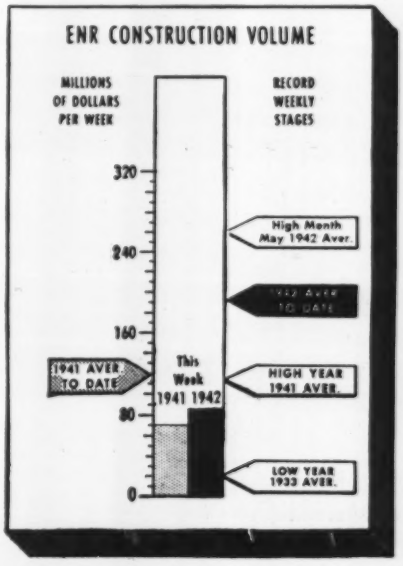
ENGINEERING CONSTRUCTION volume for the week totals $87,995,000, an increase of 25 percent over the volume for the corresponding week last year, but 44 percent lower than the total for the preceding week. Federal work, accounting for 91 percent of the volume, is 138 percent above the 1941-week total, but is 44 percent lower than a week ago. It is responsible for the 54 percent gain in public construction as compared with last year, and is the principal reason for the 45 percent decline from last week. Private construction is 72 and 11 percent lower, respectively, than in the 1941 week and in the preceding week.

The current week's construction brings 1942 volume to $8,221,303,000, an increase of 60 percent over the 43-week period in 1941. Private work, $504,294,000, declines 51 percent from last year, but public work, $7,717,009,000, is 87 percent higher than a year ago as a result of the 136 percent gain in federal work.

In the classified construction groups, gains over the 1941 week are in waterworks, sewerage, public buildings, and unclassified construction. Increases over last week are in waterworks, sewerage, bridges, industrial buildings, and earthwork and drainage.

New capital for construction purposes for the week totals $21,178,000, an increase of 1 percent over the volume for the week last year. The current week's new financing volume is made up of $20,178,000 in state and municipal bond sales, and $1,000,000 in RFC loans for public construction.

New construction financing for the year to date, $9,554,598,000, is 61 percent above the $5,930,530,000 reported for the 43-week period in 1941.



CONTRACTS

(Thousands of dollars)

	Week Ending Oct. 23 1941	Oct. 15 1942	Oct. 22 1942
Federal	$ 33,665	$143,836	$ 80,235
State & Municipal	20,730	8,727	3,335
Total public	$ 54,395	$152,563	$ 83,570
Total private	15,931	4,963	4,425
TOTALS	$ 70,326	$157,526	$ 87,995
Cumulative 1942	(43 weeks)		$8,221,303
1941	(43 weeks)		$5,147,515

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1941 43 weeks	1942 43 weeks
NON-FEDERAL	$1,104,412	$587,700
Corp. Securities	320,871	169,889
State & Mun.	382,281	204,656
U.S.H.A. loans	30,399	.....
R.E.A. loans	100,500	.....
R.F.C. loans	107,361	130,455
Fed.-Aid—Highways	163,000	82,700
FEDERAL	$4,826,118	$8,966,898
TOTAL CAPITAL	$5,930,530	$9,554,598

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	Oct. '42	282.44	135.77
Building Cost	Oct. '42	225.90	122.11
Volume	Sept. '42	544	238

FHA MORTGAGES

	Week Ending Oct. 18 1941	Oct. 10 1942	Oct. 17 1942
Selected for appraisal			
Title II	$19,293	$5,696	$5,190*
Title VI	$3,702	$12,090	$17,810*

*Subject to revision.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

State-Financed Housing

Sir: The news item (*ENR*, Aug. 13, 1942, p. 204) announcing the opening of the Fort Greene Houses Project for war workers in Brooklyn is an excellent summary but contains one incorrect statement. The last paragraph refers to construction of the project by the New York City Housing Authority, which is correct, but states that the financing was by the USHA, which is incorrect. Fort Greene Houses is being financed by the New York State Division of Housing.

It is, in fact, the first public housing project under the state program and, although undertaken originally for low-income families, will be used as war housing for the duration. At the end of the war it will become available for low-income families as originally intended, at which time both the state and the city will join in making such subsidy payments as may be required to maintain the low-rent character of the project.

EDWARD WEINFELD
New York State Commissioner of Housing
New York, N. Y.

Wartime Education

President James V. Conant of Harvard University, speaking to the freshmen recently, took an unusually realistic view of the prospects before them. He said "If by next Spring our forces are actively engaged on many fronts and the casualties begin to mount, no able-bodied young man will wish to be placed in the position of having consciously avoided the risks of battle. The government may well have to hold some of you in colleges or universities for special training—for example, as embryonic engineers or medical men—but the orders must clearly come from the government. No one has the right to ask you to make that choice.

"If my prediction as to the future is correct, you of the class of 1946 will be called into active service long before the completion of your college course. You must consider, therefore, each of you, how you will use most effectively the short academic period which lies ahead. I venture to suggest that it is of the greatest importance for you to discover whether or not you have talent for those types of technical work which play so important a part in modern war. It is vital to the war effort that these talents be discovered.

"I hardly need to underline the fact that there is little relation between the academic days which lie before you and those of a peaceful college year. You will be toughening your physique by physical training and developing your intellectual muscles for definite goals. Only a trace of the broadening background of a liberal arts college curriculum can survive in these grim days. But when the war is won, it is our hope that you will return to a college once again transformed, transformed then for the work of peace. At that time the true purpose of education will again be in the forefront."

Dynamics and Bridge Design

Sir: From time to time we are reminded of serious shortcomings in our methods of structural design by certain events that illuminate, sometimes dramatically and like a flash, the boundaries of our knowledge. The collapse of the Tacoma Narrows Bridge is the most recent of these events; a new aspect was opened—that of aerodynamic instability of suspension bridges—in a manner not too pleasant. The collapse of the large Vierendeel-girder across the Albert Canal near Hasselt in Belgium some four years ago, fourteen months after it had been opened for traffic, gave a stern warning that the then limited knowledge of the strength properties of welded, low-alloy steel structures subject to dynamic loads did not yet warrant the safe design of a fully welded truss. Each accident not traceable to neglect, incompetence or force majeure has thus initiated new research and been an impulse to progress.

Surveying retrospectively the underlying causes of those two most recent collapses, as well as [illegible] number of earlier accidents in [illegible]erent countries, we find that in [illegible] case the manifestation of a new [illegible]nome-non, hitherto unknown or [illegible]dered either irrelevant or negligibl[illegible]ould be pointed out as the most [illegible]dable cause of failure. And it is sig[illegible]icant that it was unexpected *dyna*[illegible] as-pects of structural behavi[illegible] to which the failures could be tr[illegible]d in both accidents. These are th[illegible] facts which make a thorough and ex[illegible]sive investigation of the dynamic [illegible]ffects in bridges and their influen[illegible] on structural design a matter of [illegible]onsid-erable importance and urgency. This investigation will require the con-certed effort of a considerable number of research workers and institutions. A brief outline of the problems involved may serve as an impulse and a tentative suggestion of a program.

The dynamics of the load and of the structure and the behaviour of structural materials under dynamic strain are the three main problems in the design of bridges. Not one of them has, so far, been covered by rational and comprehensive research. The numerous partial investigations could not lead to conclusive results. Neither can the vast factual evidence accumulated through these investigations be effectively utilized because most of the experiments, lacking the guidance of a reasonable theoretical concept, have neither been adequately planned nor performed under conditions reasonably controlled. These deficiencies have deprived the results of a common system of reference, and thus turned the data into a mass of incoordinate and sometimes even erratic information. Even the most fundamental discrimination, that between assignable and chance causes, has generally not been attempted.

Here is one of the most striking examples of the necessity to separate assignable from chance effects, and to apply casual-functional methods in the investigation of the former and statistical methods to large numbers of observations of the latter.

The joint consideration of the dynamics of load and structure by the summary means of a simple multiplier of the static weight, the impact factor, represents the conventional procedure. It is, however, highly inadequate because the complex effects of the repeated transformation of potential (strain) energy into kinetic (vibration) energy and vice versa,

which takes place during the passage of the load over the structure, can neither be described nor even approximated by a factor of proportionality. Discrimination between functional and statistical causality shows the dynamic impulse of the traveling load to be almost an entirely assignable effect of weight and traveling speed, whereas the dynamic behaviour of the structure appears predominantly chance-sensitive. The latter is decisively affected by the number and frequency of consecutive load impulses, by the state of the roadway, and by the general state of the structure, which in its turn depends on the initial stage, age and maintenance. This last factor can very concisely be expressed by the damping capacity.

Research of the dynamic resistance of structural materials has, so far, been restricted to the determination of the breaking strength of different samples subject to repeated stress cycles, mainly full reversals, or to the conventional forms of impact loading. Data relating resistance and number of stress cycles of amplitudes other than full reversal are very limited. Similarly, the influence of the velocity of strain upon the strength of the material and the resistance of the structure has not yet received the attention it deserves. Neither has it been generally recognized that the character and extent of deformation are primarily affected by the rate at which strain energy is applied in comparison with the rate at which part of this energy is dissipated through heat, that is without structural damage. The whole question as to what extent redistribution of stresses in structures and relief of peak stresses is bound to occur can be reduced to the question of whether the rate at which strain energy is applied does not exceed the speed at which it can be dissipated, so considerably that the material appears brittle, with the yield limit raised so far as to prevent the manifestation of the permanent deformation essential for such relief.

It is, however, not only the resistance of structural members in tension or in bending that is thus affected by the strain rate; the buckling resistance of compressed members is equally a function of the velocity of strain. The increase of the yield limit with the strain rate applied leads to an extension of the validity of the Euler-hyperbola for elastic buckling beyond its conventional range, delimited by the yield limit for static load, a fact entirely neglected in buckling research.

An uneasiness about the structural significance of conventional tests and growing doubts about the application of test results to design are becoming increasingly evident among engineers. In the recent symposium on the tension test of the American Society of Testing Materials these doubts were strongly voiced, particularly as regards the characteristics conventionally considered representative of high dynamic resistance of structural materials. A fundamentally new approach to problems of dynamic strength appears to be necessary, and it is almost certain that a thorough investigation of the damping capacity of structural materials, as well as of whole structures, its significance and implications, will prove to be of considerable bearing upon the subject. It is an adequate knowledge about the phenomenon of damping in all its aspects which may be the key to the understanding of most of the phenomena of dynamic resistance, including that of resistance to occasional overstress.

This problem is of particular importance in the design of bridges and other structures in which the frequency of occurrence of the maximum load intensity is but a small fraction of the frequency of occurrence of load impulses of average (service) intensity and in which this latter is considerably lower than the maximum. The stresses induced by maximum load should, therefore, be considered occasional overstressing of the structure designed to withstand a very frequent or infinite repetition of the average service stress. Such procedure of design, entailing considerable economy would, however, be possible only if the capacity of the material to sustain overstress of definite amplitude and frequency could be ascertained by standard tests.

But the small number of tests performed to determine the relation between the overstress and the number of overstress cycles sustained without either immediate damage or adverse effect upon the final resistance to frequently repeated service stress, the "damage-line," suggests that the test procedure is far too laborious and lengthy to be applied in testing for immediate engineering purposes. A practical procedure will have to be based on some more rapidly determinable representative property, such as the damping capacity. It can be proved, even theoretically, that a definite correlation must exist between the capacity of a material to sustain occasional overstress and the form of its "damping-curve," that is the relation between the specific damping capacity and the pertaining stress amplitude.

The solution of all the problems mentioned will lead to a highly improved insight into the behaviour of structures subject to dynamic loads and thus considerably affect the design of bridges. The necessary research is predominantly experimental. But it will have to be preceded by the establishment of certain fundamental, theoretical concepts and relationships in order to restrict the range of the experimental investigations, the volume of which might otherwise become almost prohibitive. These concepts, reproducing the fundamental functional relations between the relevant physical qualities, will be constantly improved according to the new factual evidence available, and serve as guides for further experimental research.

ALFRED M. FREUDENTHAL
Consulting Engineer
Tel-Aviv, Palestine.

Handling Ship Plates

Sir: We were interested in the article (*ENR*, July 30, 1942, p. 183) dealing with the use of our "Hyster" straddle trucks for transporting steel plate in shipyards. These trucks are essentially the same as the straddle trucks we have produced for a good many years, which are used extensively in the lumber industry for transporting lumber and in other industries for handling many kinds of merchandise. However, the ones used in the shipyards are much higher in the load space than the regular machines.

Our company, with the cooperation of the Oregon Shipbuilding Corp., developed these plate-handling straddle trucks which, we are very happy to say, have played a very important part in making possible the outstanding shipbuilding records that have been established by the Kaiser yards.

M. R. PATE
Willamette Hyster Co.
Portland, Ore.

EDITORIALS

VOLUME 129 NUMBER 17

October 22, 1942

A Special Obligation

THE CONSTRUCTION INDUSTRY and public works organizations have a special obligation in the current campaign for scrap metal. As large users of steel and metal products, they must also be collectors of scrap metal. The economics of the case are simple—steel is needed to build war production plants which in turn will consume more steel to make weapons and tools. To produce steel, we must have scrap to take the place of present inadequate pig-iron capacity. Quantities of waste metal are available on every construction job, and quantities of obsolete machinery in most construction "back lots." Municipal and state agencies can produce much, too, in the way of old equipment, outmoded streetlight standards, streetcar rails, old buildings, ornamental fences, and the like. Dump the junk on the scrap pile. It will never again be as useful as it is today.

Emergency Concrete Design

IN DEVELOPING a war specification for reinforced concrete building design, the WPB specifications branch continues the good work of steel conservation begun with its emergency specification covering structural steel buildings. Probably under present conditions the concrete specification will enjoy wider use than the steel specification but, as representative of a new approach to specification writing, both are equally significant. In normal times the primary objective in the preparation of such a design specification or code is the safe, efficient and economical use of the material. High safety factors are the rule to guard against incompetent design. In these emergency codes, however, there is only one criterion—the saving of as much steel as possible, by raising the unit design stress for the steel. If factors of safety are reduced—as they are for structural steel and may be for reinforced concrete—that is a price that must be paid. With the reinforced concrete code, however, it is not patently clear that over-all safety factors are reduced, because of the lower stresses prescribed for the concrete. In any event, the concrete code raises questions of its post-war effect just as the steel code did. We can be certain that the experience that designers accumulate in using these new codes will at least be reflected in discussions of code revisions after the war, and many more people than formerly will take an active interest in code matters. And that will be all to the good.

Engineer-Contractor Collaboration

WHEN THOSE who will actually build a structure are given an opportunity to assist in its layout and design, the result is usually worth the effort. Because the contractor thinks in terms of speed and economy, and can often evaluate designs in terms of available materials and labor, his collaboration is particularly useful today. As, for example, on a war factory described in this issue. Here the owner's requirements for space were fully met in a one-story building of concrete, which is said to require less steel than a timber structure, and less skilled labor, less ton-miles of haul and less time to build than if any other material had been used. The speed of construction and economy of critical materials were made possible by giving first consideration to the problems of construction, and designing the structure to accommodate a selected method of building. That the structure cost no more than a number of other possible designs investigated is further reason for satisfaction with the engineer-contractor collaboration that was practiced on this job.

New Building Concepts

BECAUSE of its unprecedented size and shape, and its use of ramps for movement of pedestrians, the War Department's huge new Pentagon Building, described in this issue, is of peculiar interest to the architect and building designer. Being the world's largest building and spreading its 4,000,000 sq. ft. on only five floors, it raises the question of practicality—of whether large office buildings of low height are economical and efficient. Equally as important as the question of size is that of general layout and space arrangement. A five-sided structure in which the offices occur in concentric rings seemed to offer many advantages to the designers of the Pentagon Building, but the proof remains to be established from operating experience. Likewise, to employ ramps for pedestrian movement from floor to floor is an innovation that will be watched with interest; in the portions of the Pentagon Building already in service, the ramps are said to be exhibiting many advantages over elevators and stairs. In all of these particulars the

Pentagon Building is as daring as it is huge. Its designers have done a pioneering job which may have important effects on post-war buildings.

Young Men and the War

THERE IS MUCH TALK among college officials and at gatherings of engineers with respect to training engineers to meet civil and military needs in this war emergency. As the subject is of concern to older engineers as well as to the young men seeking engineering training, it calls for early consideration if a proper solution is to be found quickly.

Pending legislation to lower the draft age to 18 makes it certain that most of the young men now in college and many of those who will graduate from high schools in the near future will be subject to draft before they have had an opportunity to go far with their higher education. Though the final draft of that legislation was not available when this was written, it appears probable that the amended act will provide deferment only for completion of the term in which a young man became of draft age. Under such a condition, our college halls will be emptied rapidly unless draft boards or the administrators of the Selective Service Act can be prevailed upon to leave some boys in college to complete their courses.

Many engineering educators greatly deplore this prospect. They are urging not only deferment of engineering students now in college but subsidies for potential engineering students in order to train men to meet the current shortage of engineers. Superficially their arguments appear sound; actually they lack realism. The shortage of engineers is a matter of today, not of three years hence. The need for men in the army and navy is now, not three years from now.

President Conant of Harvard summed up the situation most realistically when he told Harvard freshmen that their days in school were numbered and urged them to make the most of those days by training themselves for military service.

What then of the shortage of engineers in war industries and the military services? There is but one way to meet it—by shifting older men with engineering training from non-essential occupations to fill the gaps in war industries and by calling more young engineers into the services. Many of the older men may have to be sent back to school for refresher courses, but that will be but a matter of weeks or months at the best, not years, as in the case of the boys now entering college.

This is not to say that some of the young men now well along in their engineering training should not be permitted to complete that training. They should, if there is need for their special skills, but the number of these men is not large.

There also is much confused thinking about the shortage of engineers, current needs being set at many thousands by some industrialists and engineering educators. The pressing need of war industries that totals to such large figures is for technicians rather than for engineers when that term is used in its proper sense. Technicians can and are being trained to meet those needs in courses covering weeks, not years. Most of our engineering schools are conducting such training courses.

What is needed is a wholesale reorientation of our thinking with respect to engineering training in the war period. Teaching of engineering designed to make a properly trained professional man should be abandoned for the duration, and our engineering schools should be converted into technical schools where young men are trained to meet the needs of the military services and war industries. Modification of the Selective Service Act may be necessary to make this training of greatest usefulness because control over the boys in those schools should be taken out of the hands of their home-town draft boards and placed in the hands of men at the schools who should have power to determine with finality whether a young man is to be assigned to a war industry or to one of the military services.

We have vast resources of untrained skills in the young men already in the armed forces or about to be drafted, but unless engineers and educators take the lead in developing these resources they will be largely dissipated. Unrest and indecision already are undermining the work of the boys now in college because they lack guidance and are harassed by recruiting officers who appear before them at frequent intervals. As President Conant said to the Harvard freshman, they should not be asked to make the decision as to whether they should stay in college while other boys are being sent to battle. The decision should be made for them. Engineers and engineering educators have an unparalleled opportunity for service to these potential engineers and to the country in seeing that order is brought out of this chaotic condition.

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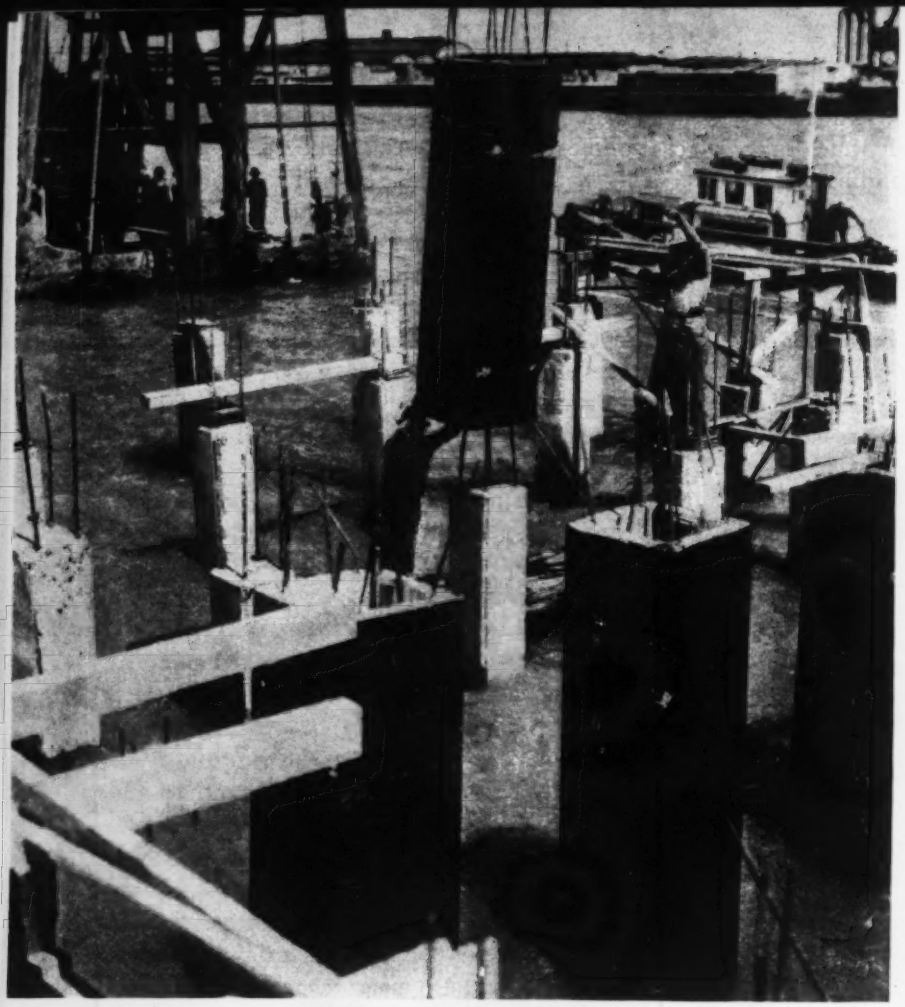

Fig. 1. Precast jacket being lowered to place over a driven pile. In background is piledriver with two jets.

Concrete Jackets Make Up For Unequal Pile Lengths

***Contents in Brief**—Difficult driving was simplified by precast jackets that relieved exact requirements on length and position of reinforced-concrete piles in piers designed for loads of 1,000 lb. per sq. ft. Precast concrete jackets also were put around batter piles of untreated timber, after driving.*

THE U. S. NAVY required a pier that would carry a live load of 1,000 lb. per sq.ft. at a location where it was known that the cemented sand bottom would make pile driving difficult. The need, clearly, was for reinforced-concrete piles, but it would not be easy to determine beforehand what lengths to use in order that, after driving, the tops would be at exactly the desired elevation without expensive cutting of the pile heads. A satisfactory solution was found by use of a precast concrete jacket placed over the top of each pile after it had been driven. The jacket compensated for the differences in driven depths and its larger top area gave a wider bearing on which to support deck beams.

Another advantage of the jacket is in the increased life to be expected if any concrete deterioration should occur by reason of exposure to sea water. Where such deterioration has occurred in other structures it has been limited to a zone above low-water line and chiefly above high-water line—the zone in which the jackets provide extra protection in the form of added thickness.

The pier is 250x1,250 ft. in plan and the design called for 4,132 reinforced-concrete piles. These are 18 in. square and were cast in lengths of 42 to 60 ft. After driving, each pile was topped with a precast reinforced-concrete jacket whose upper end was brought carefully to a predetermined level. In addition to these plumb piles, 416 batter piles were required. These were driven of bare untreated timber using an inclined-lead attachment to a floating driver. The batter piles were put down butt first to increase bearing area and to decrease the size of precast jackets that could be slipped down over their tops after they are driven. Because it was desired to have these jackets give protection 15 to 18 ft. below the mud line, lengths of 38 to 52 ft. were required. They were all made 22 in. square (with corners flattened) and the open core in the center was made 16 in. in diameter. This allowed ample space for grouting around even the larger wood piles.

Driving procedure

Despite the cemented sand bottom and the fact that constant operation of double jets was required, a driving procedure was developed with which progress was rapid. Precast piles were brought in by barges moored within convenient reach of the driver, which was held in place by four lines, each with a separate engine control. The driver could thus be moved alongside the barge and the piles could be picked up with a three-point support from two lines over sheaves at the top of the leads. Then the barge would be moving back to position for driving while the pile was being put into position in the leads. This was done by slacking off on the line that controlled two of the three supports and allowing the pile to hang by the choker near one end. The pile was then worked in between the leads.

Location for each pile was marked by a red tag on a wire stretched across the pier 3 ft. inshore from the prescribed line of pile centers.

Although procedure varied somewhat with differences in the bottom, two jets were operated almost continuously during driving. Each jet, operated by a separate hoist, was supplied by its own pump delivering about 600 gpm. at a pressure of

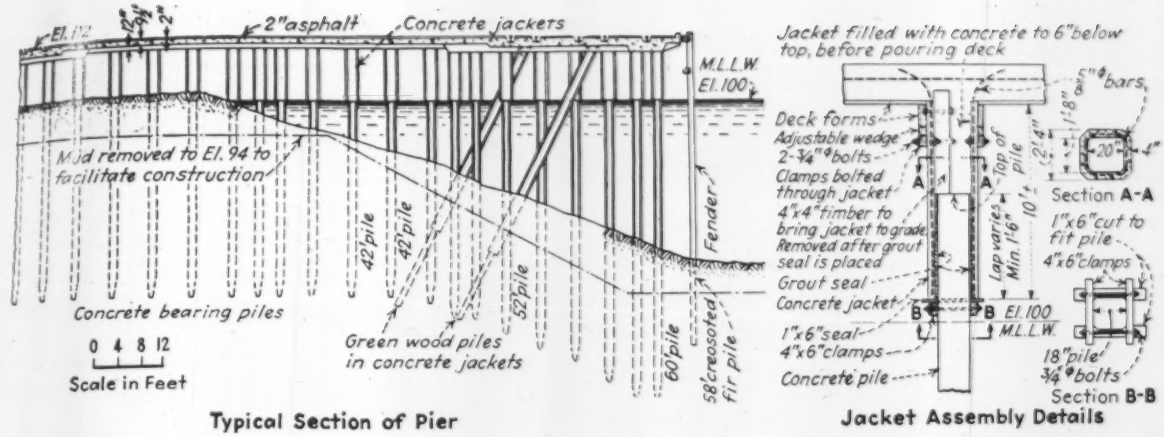

Fig. 2. Typical sections of pier and details indicating methods of assembly for installing jackets around tops of the piles.

200 lb. per sq.in. The diameter of the jet at the nozzle was 1 in.

A double-acting steam hammer was used, striking 111 blows per minute with a rated energy of 24,450 ft.lb., cushioned by a pine block 8 in. thick made up of 1-in. laminations.

When a row of piles was completed, readings were taken on the top of each pile with a level instrument. Based on this elevation reading, a 4x4-in. timber was cut of a length such that when bolted to the inside of a precast jacket, the jacket would slip down over the pile and be supported by the 4x4 at just the prescribed height. A timber frame was then bolted around the piles at the lower end of the jackets, as shown in the drawing, to serve as the bottom form for retaining the concrete with which the jacket was then filled. The 4x4 was removed after the weight of the jacket was carried by the frame bolted on at the bottom and before the jacket was filled with concrete. To guide the jackets and insure space for grout on all sides between pile and jacket, concrete projections in pairs were provided on the inside of the jackets. These were formed by indentations in the steel forms, their length was such as to allow only a ½-in. clearance all around, between the surface of the pile and the inner face of the projection.

Reinforcing rods projecting from the top of the pile served as support for additional reinforcing which extended up through the jacket and projected into the floorbeams. Forms for the floorbeams to rest on top of the jackets were bolted in place around the outside of the jackets.

Forms for the pier deck were coated on the inside with tar and gravel. The gravel is applied in such a way that it projects above the tar surface to provide the best possible bond between tar and concrete when the latter is poured. Any loose gravel, after the tar has hardened, is removed with an air jet. Thus, when forms are stripped, a protecting tar coating is already in place on the concrete surface.

Most of the batter piles were used under the crane tracks and the railroad tracks which were designed for a 30-ton locomotive crane whose load concentration exceeded that of a locomotive loading.

Placing concrete jackets

Jackets for both the plumb and the batter piles were handled and placed

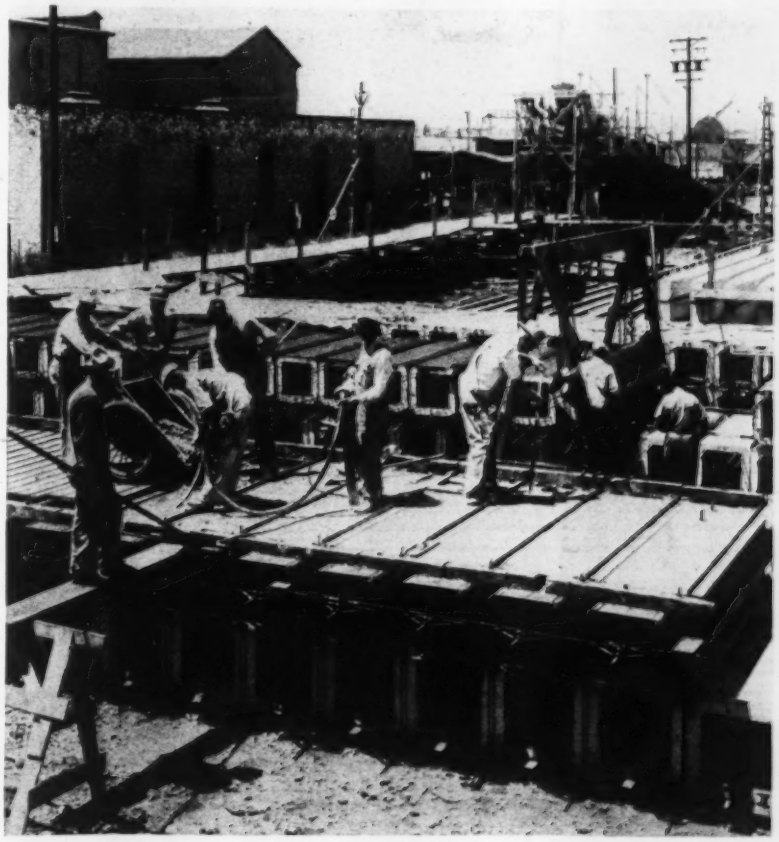

Fig. 3. Casting yard where piles and precast jackets were made. In left center is ramp from which truck-mixed concrete was delivered to buggies. Note collapsible steel forms for jackets.

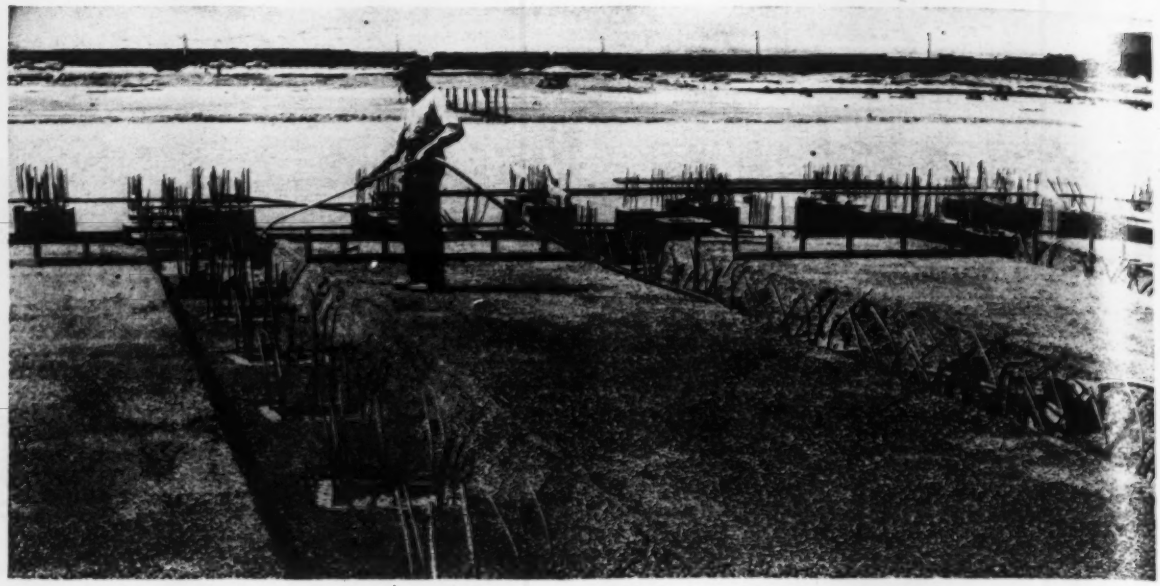

Fig. 4. Ready for deck pour. Reinforcing projects from the jackets into forms for the floor beams. Tar and gravel coating on forms will bond into concrete for permanent protection of surface.

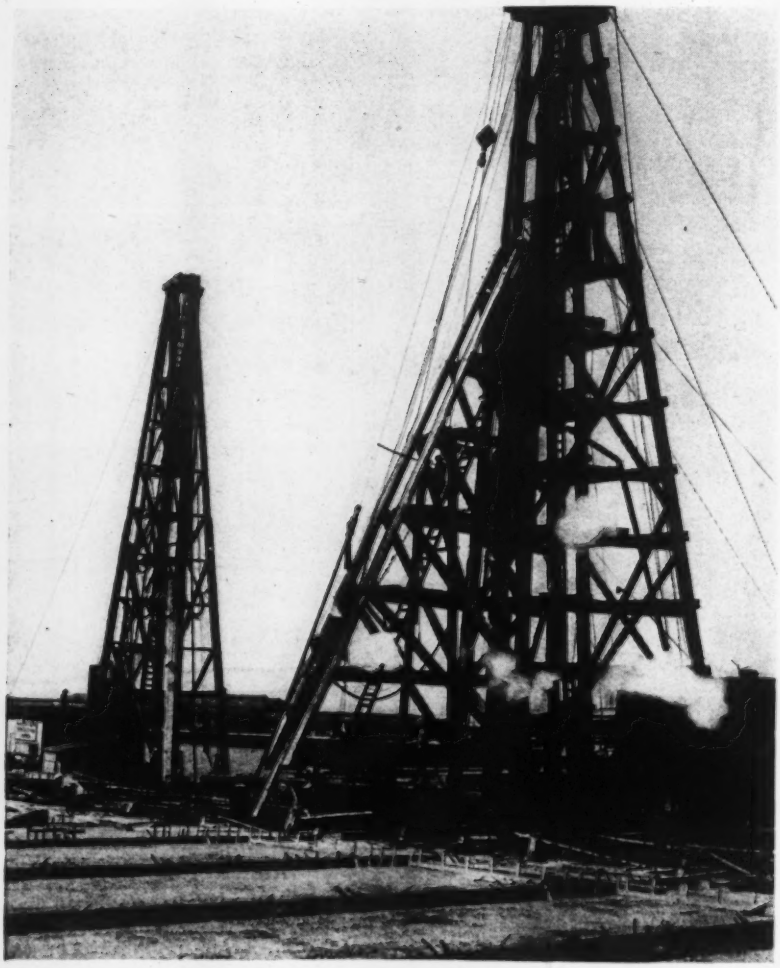

Fig. 5. Driving the untreated batter piles with supplementary inclined leads. Concrete piledriver in background.

by a derrick barge moored alongside the delivery barge. The jackets were lifted, swung into position over the piles, and lowered to place. With the "short" jackets (standard 9½ ft.—under the railroad tracks 8 ft. 9 in.) used on the plumb piles, the 4x4 stop automatically brought the jackets to the prescribed level. In the case of the longer jackets for the batter piles, jacket tops were brought to the prescribed level by driving with a single-acting hammer.

Grouting around the short jackets was accomplished by pouring concrete (using rock sizes not exceeding ¾ in.) into the jackets from hand buggies through a funnel of convenient size.

As jackets for untreated timber batter piles were put down below water level, sea water rose up in the space between pile and jacket. However, a rubber gasket, attached to the bottom of each pile before driving, fitted close enough to retain grout put down as a seal.

For a length of about 5 ft. at the bottom of the jacket the space between pile and jacket was filled with grout put down through a 2-in. pipe topped with a rectangular funnel into which the grout was poured. The bottom of the 2-in. pipe was flattened to permit its being thrust into the narrow space between the timber pile and the jacket. Grout for the seal was made of a 1:1½ combination of cement and sand. After the bottom

seal had been allowed to set, the remainder of the jacket was filled with a concrete made of 7½ sacks of cement per yard, using aggregate not exceeding ¾ in. in size.

Concrete piles and jackets for plumb and batter piles were cast in a yard not far from the pier where a barge could be used for pile deliveries. From the barge mooring at the yard a standard gage railroad track ran the entire length of the casting area. A locomotive crane on this track picked up the piles with a spreader and tongs and loaded them on the barge.

The yard was laid out in sections in which piles and jackets were cast parallel to the railroad rails with forms resting on sills laid on the ground. This foundation was sufficient to carry the weight of a tier four piles deep. Concrete was brought to the yard as required in mixer-type trucks and delivered from the upper end of the inclined ramps from which vantage points gravity delivery reached all of the casting area.

The collapsible cores for the batter pile jackets that ranged up to 52 ft. in length were of interest in that marked improvement was made in design during operations on this job. The improved form consisted of a collapsible cylindrical mandrel with an outer surface of hard steel plates. A steel rod extended the entire length of the mandrel and was actuated at one end by a hand crank and a stationary nut through which a threaded portion of the rod passed. At 3-ft. intervals along the mandrel the central rod was threaded through toggle arms which were connected to driving rod and anchor points on the inside of the cylindrical shell in such a way that when the central rod moved lengthwise these toggles increased or decreased the diameter of the cylinder by movement of the steel plates that constituted the shell.

With this arrangement it was a simple operation to increase or decrease the diameter of the mandrel for its entire length. Ordinarily it was withdrawn soon after the concrete had begun to set. The usual procedure was to unwind just enough to break the bond with the concrete about 24 hours after pouring. Thereafter the mandrel could be withdrawn at any convenient time before the concrete jacket was loaded on the delivery barge.

For concrete protection in the tidal range the jackets were coated with asphalt mopped on hot over a primer consisting of 70 percent distillate and 30 percent roofing asphalt.

Fig. 6. Hopper and 2-in. pipe through which grout seal was placed in jacket of batter piles.

The contract for construction of the pier is held by a combination of contractors including Clinton Construction Co., Dinwiddie Construction Co., Duncanson & Harrellson and Monson Bros. Designs were developed by Frank G. White and H. E. Squire, San Francisco, consultants.

Erosion Control with Cotton Fabric

EXPERIMENTAL use of cotton fabric to control erosion in ditches and on slopes along highways in Mississippi is reported by District 8 of the Public Roads Administration in the quarterly issue (July-August-September, 1942) of "Public Roads."

The fabric used was of the following types: S1-54, S1-40, S2-54, and S2-40, the latter figure of each designation being the width of the fabric in inches. Both types have relatively large mesh openings, Type S1 having six openings per inch, and Type S2 having four.

Conclusions drawn to date from these tests are as follows:

1. There is no apparent advantage in using cotton fabric on 3:1 or flatter slopes that have been treated with a mixture of grass roots and topsoil.

2. Use of cotton fabric has some advantage in shading growth and retarding erosion on 2:1 and 1½:1 slopes that have been treated with a mixture of grass roots and topsoil or sprigged or strip sodded. However, straw mulch serves better and is more economical when available.

3. Cotton fabric aids natural growth and retards erosion on 4:1 slopes as sandy clay and clay soil that have received no other treatment. However, straw mulch serves better wherever available.

4. There is definite advantage in using fabric in roadside ditch bottoms in promoting growth and retarding erosion.

5. The S2-54 fabric is more effective than the other types. The open mesh of S2 fabric allows vegetation to grow through it, and the wider material is more economical to install per square yard.

6. For greatest effectiveness, the fabric should be placed up and down on slopes and parallel to the flow line in ditches.

7. Galvanized wire staples are more effective than wood stakes in pegging the fabric.

Fire Prevention in Building Army Camps

Fig. 1. Fire trucks and tank trucks were among the first pieces of equipment brought onto the job.

***Contents in Brief**—When the contractor moved on the site to build a large Army camp there was no water supply available. Knowing that handling more than 50,000,000 b.ft. of lumber in a few weeks would create a serious fire hazard, the contractor built nine temporary reservoirs in the area, each of about 25,000-gal. capacity, and equipped two trucks with water tanks of 1,000 and 2,000-gal. capacity. One of the five permanent camp fire houses was built immediately and combination firemen-watchmen were stationed at strategic points.*

An Important Part of the contractor's work in building a large camp was to provide precautions against fire hazards. At the start of the work no water supply was available for fire protection and since 50,000,000 b.ft. of lumber was to be used, a potentially serious conflagration hazard was created. One of the first jobs of the contractor was to build nine reservoirs in the area, each of 25,000-gal. capacity. Some of these reservoirs were created by damming up available streams. At other sites water storage was provided by excavating at favorable locations and constructing sumps.

Two motor trucks were equipped with tanks of 1,000 to 2,000-gal. capacity to transport water to any possible fire. The tanks of these trucks were kept filled at all times and the trucks were manned by men who later were to form part of the permanent camp fire brigade. A fleet of several trucks was used to carry water for construction purposes, and these also were available in case of fire. At the start of construction two 500-gpm. pumpers were purchased, and a short time later two more were acquired. Each of these fire engines was equipped with a 150-gal. booster tank. All the water-tank trucks were used as feeders for the fire trucks, keeping the booster tanks full at all times in the event of a fire.

Firemen were placed at strategic points over the site and many of them were armed to act as watchmen. These workers reported by telephone to the central fire house, which was made ready for use three weeks after the contractors moved onto the site. At this station an electrical siren with two independent sources of power was installed. It was tested daily as a noon whistle.

In addition to the men with the combined duties of watchmen and fireguards, about twenty-five patrolmen were equipped with portable fire extinguishers (Fig. 2) and instructed to walk continuously about the job, each man always patrolling the same area. These men were carefully instructed as to the many different conditions that create fire hazards and of the necessary steps to correct them. The fire guards were encouraged to warn all workmen of the dangers of

Fig. 2. Twenty patrolmen equipped with 5-gal. knapsack-type fire extinguishers traveled over the job constantly to discover potential fire hazards and to put out small fires before they developed to serious proportions.

Fig. 3. As part of the permanent equipment at each of the five fire stations, three trucks of the type above were purchased, each equipped with 1,000 ft. of hose and a 750-gpm pump. The regular crew was five men, including the driver.

smoking in the vicinity of lumber and other inflammable materials. They were also given instructions in first aid.

At all times a six-man crew cruised about the site in a truck equipped with portable fire-fighting equipment. This crew augmented the patrolmen on duty.

The permanent fire-fighting facilities at each building were installed as soon as possible. At the 74-man, two-story, wood-frame barracks, 55-gal. drums were placed at two corners of the structure and filled with water, while two buckets were hung just above each drum. On the second story of each barracks three 2½-gal. hand extinguishers were installed.

Fig. 4. At two corners of the standard, two-story, 74-man barracks a 55-gal. drum was kept filled with water and two buckets were hung in full view.

Two similar units were made available on the ground floor. In the same way buckets filled with sand were placed at convenient points.

Around larger buildings, such as the messhalls, the practice was very similar to that at the barracks, except that one 55-gal. drum and two buckets were placed at each of the four corners of the structure and portable extinguishers were placed inside. At the long wood-frame warehouses, water barrels were located at frequent intervals on the loading platforms. The permanent 2½-gal. extinguishers similar to those for the barracks were installed as soon as possible.

At the peak of operations some 140 men were employed on three shifts as fireguards, watchmen and police guards. That employment of these men and the fire-prevention methods just described were very effective is proved by the fact that on the $32,000,000 job, now practically complete, no major fires have occurred and no loss by fire has resulted, despite the fact that a peak force of 12,000 men were employed.

John A. Johnson Contracting Corp. and Andrew Christenson & Son, Inc., New York City, are the general contractors. The architect-engineer is Tuttle, Seelye, Place & Raymond. The construction work was under the direction of Col. A. B. Jones, C.E., New York district engineer, U. S. Engineers, and was supervised by Maj. C. L. Bucknum, area engineer.

War Scrap Salvage Cuts Refuse Disposal Costs

GEARING its rubbish collection system to salvage scrap for the war, Highland Park, Mich., in the Detroit metropolitan area, has collected $15,867 from the sale of waste materials during the last year, at the same time reducing refuse disposal costs by $18,870, according to the American Public Works Association.

Most of the decrease in operating expenditures resulted from a reduction in the outlay for hauling, made possible through construction of a municipal salvage plant in the public works yard at a cost of $20,425. The plant was built when the city, completely surrounded by an expanding Detroit, found it would have to transport refuse 18 miles to a new dump, its old dump having reached capacity. With the plant, only the remains of the refuse after it has been salvaged or incinerated are taken to the dump.

Additional expenditure for sorting and salvaging, which amounted to $15,648 last year, was more than offset by returns from the sale of the reclaimed material, totalling $15,867 from June 30, 1941, to June 30, 1942.

The city's rubbish is hauled directly to the salvage plant, where it is sorted for reclaimable material. Combustible rubbish is burned, and the residue hauled by truck to the city dump. Of 60,515 cu.yd. of waste material handled by the plant last year, only 18,799 cu.yd.—about 30 percent—remained to be hauled to the dump. Ashes, handled separately, totaled 13,176 cu.yd. for the year.

Total distance traveled by all trucks hauling rubbish and ashes during 1941-42 was 73,944 miles, while under the former system of disposal the total distance would have amounted to 240,500 miles, requiring two additional trucks and costing an additional $18,650.

Total recovery was 1,600 tons of scrap, paper, rags and miscellaneous items from 60,515 cu.yd. of rubbish collected from 52,000 residents.

Penetrometer Control of Rolled Fill

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***Contents in Brief**—The weight of soil passing a No. 4 sieve that can be tamped into a test cylinder of known volume; a penetrometer reading; and a moisture determination on sandy materials give soil classification. On clayey materials the moisture determination can be read from control charts so that direct moisture tests are unnecessary. Thus simple field tests give the same information as tedious moisture-density and mechanical-analysis determinations.*

A METHOD OF FIELD CONTROL for tamped earth construction based on seven years of operations in the Tennessee Valley area has eliminated the most serious objections to control by test. Its simplicity and speed permit it to be used on small operations which ordinarily might not be controlled at all. This control system is based on the use of a penetrometer, similar to the plasticity needle first proposed by Proctor (*ENR*, Sept. 7, 1933, p. 286). The most serious drawbacks to the Proctor needle, aside from that of interpretation, have been the difficulty in getting a reading which could be duplicated by any number of observers, and the impossibility of getting a significant reading in materials containing an appreciable amount of stone. Now by a new design of penetrometer it has been made possible for readings to be duplicated by a number of different observers as long as all of the material tested is sufficiently fine to pass a No. 4 sieve.

The new device is shown by Fig. 1; in it the penetrating force is measured through a column of oil running to a Bourden gage. The gage linkage is adjusted to read total pressure, allowing for the weight of the instrument. An ellipsoidal penetrating point is used, and depth of penetration is controlled by a stop. Readings are expressed in pounds per square inch, or gage reading divided by the area of the maximum horizontal section of the penetrating point. This instrument has proved very satisfactory for all materials except cohesionless sands.

The following discussion applies to soils, all of which pass a No. 4 sieve. It is well known that, in general, the greater the grain size of the soil, the lower is its moisture absorption, cohesive strength, compressibility, plasticity and elasticity, and the greater is the frictional resistance between grains, permeability and density after a given compaction. Since a penetrometer reading is essentially a measure of cohesion, the lower the moisture content corresponding to a given needle reading, the greater is the grain size of the soil. Therefore a series of curves expressing the relationship between moisture and penetrometer reading for each of a number of soils may be considered as a rough soil identification chart. In support of this statement, Fig. 2 is offered; grain-size distribution curves are shown at the right and the corresponding moisture-penetrometer-reading curves are given at the left.

In Fig. 3 are shown conventional moisture-density diagrams (Proctor, R.R., "Fundamental Principles of Soil Compaction," *ENR*, Aug. 31, 1933, p. 245). They are numbered to correspond with Fig. 2. Curves having the same number in these figures were drawn for the same soil. Disregarding moistures lower than optimum, note the point on Fig. 3, at which the horizontal line representing a dry density of 90 lb. per cu.ft. crosses curves Nos. 8 and 9. This represents a moisture content of 30.9 percent. On Fig. 2, the horizontal line representing this moisture crosses line No. 8 at a penetrometer reading of 205 lb. per sq.in., and line No. 9 at 800 lb. per sq.in. From the family of moisture-density curves on Fig. 3, and of moisture-penetrometer-reading lines on Fig. 2, it is apparent that any other material, represented by a curve lying between No. 8 and No. 9, would have a density of 90 lb. per cu.ft. at this moisture. It is evident, from the moisture-density curves of Fig. 3, that a series of density contours may be derived as shown by the dashed lines in Fig. 2. The dotted curve, 0-0, in Fig. 2 is the same locus of optimum shown as line 0-0 in Fig. 3.

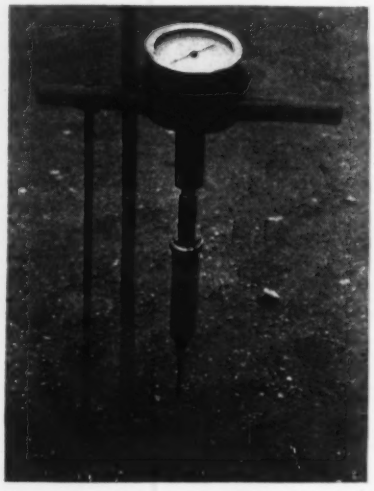


Fig. 1. Special penetrometer for field control of tamped earth structures.

Since several soils having different grain-size distribution and moisture-density curves may show the same moisture-penetrometer-reading line, the density contours and locus of optimums shown in Fig. 2 are valid only for one particular set of soils. Variations from this set of density relationships are due to (1) the effect of specific gravity of grains; (2) effect of dissolved electrolytes in the pore water; and (3) grading and grain shape.

Specific Gravity—The effect of specific gravity of grains may be visualized by considering in Fig. 3 the similarity of the envelope of moisture-density curves, line 1-1, and the line of zero air voids, line 2-2. Line 2-2 simply expresses the equation

$$\frac{M_s}{100} = 62.4/W - 1/s \quad \ldots\ldots (1)$$

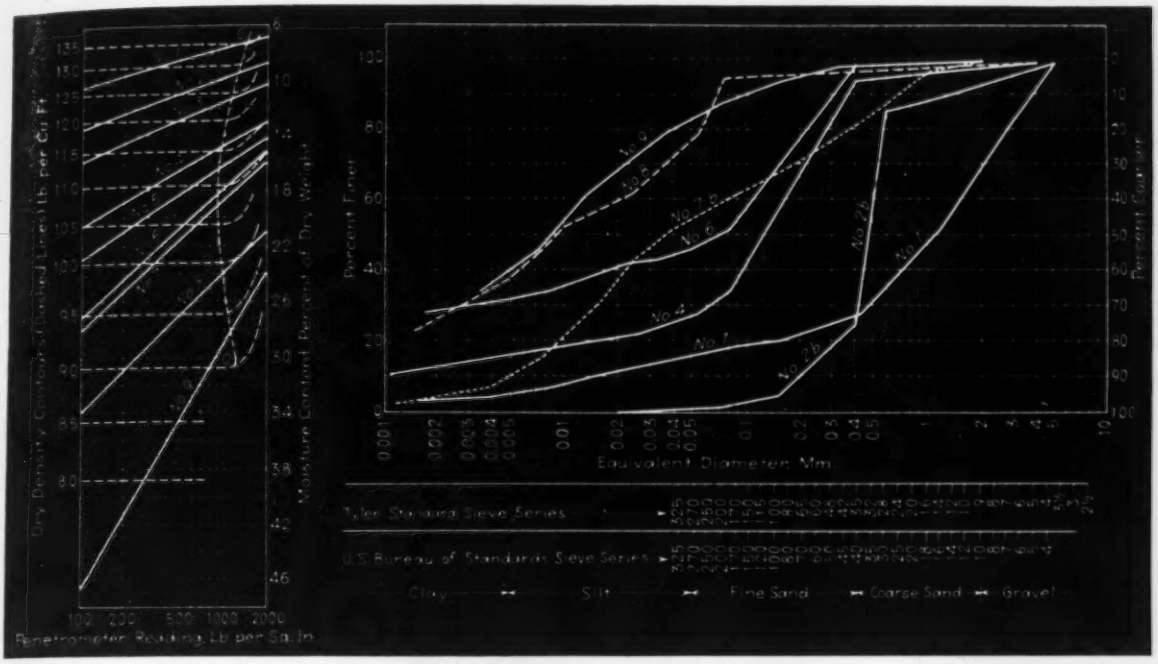


Fig. 2. Chart of relationships between grain size, grading, moisture, density and penetrometer strength.

where M_s is moisture content at saturation; W is weight of solids per cubic foot of earth, which varies, for fine aggregate, from 80 to 135 lb.; and s is the specific gravity of grains, which commonly varies from 2.63 to 2.80. Hence, if all other factors are held constant and specific gravity is allowed to vary, line 2-2 will move horizontally through a range of about 2 percent of moisture. Line 1-1 will move through the same range, staying at nearly constant horizontal distance from 2-2.

Therefore, if line 1-1 is drawn for a specific gravity of grains of 2.71, variations due to specific gravity are reduced to a maximum of about 1 percent of moisture or 3 lb. of density for density contours drawn from this envelope. Since the locus of optimums is parallel to the envelope and the zero air voids curve, it will hold within the same limits.

Electrolytes—An important effect of dissolved electrolytes in the pore water is that they change cohesion by varying the amount of surface tension. Variation of this factor alone changes none of the relationships shown in Figs. 2 and 3 except that of grain-size distribution. For example, consider each of the curves shown in these figures corresponding to No. 4 and 8. These conform to the same locus of optimums, envelope of moisture-density curves and family of moisture - penetrometer - reading lines, and show a variation in grain size consistent with the generalities given in the first paragraph of this section. But the soil corresponding to No. 8, when mixed with 5 percent calcium chloride by weight, gave moisture-penetrometer line and moisture-density curve No. 4. This indicates that classification by moisture-penetrometer-reading lines is in some cases more reliable than by grain-size distribution.

Shape and Grading—Grain shape exerts no appreciable influence on densities of materials containing large amounts of clay and colloids, since very fine particles tend to assume about the same shape, which is similar to that of mica plates (Ross, C.S., *Journal of Sedimentary Petrography*, *1*, 55-65, 1931). However, the effects (on the density contours of Fig. 2) of grading of particle sizes is profound (Burmister, D.M., *Columbia University Department of Civil Engineering Bulletin* 6, June, 1938). The greater the range of sizes in the soil, the higher will be its density; the more uniform the grading, the lower is the density. The clays represented in Fig. 2 by moisture-penetrometer-reading line No. 8 and those below it are uniform and fine. Therefore, they can only be compacted to low densities. As the material becomes better graded, and so more dense, it necessarily must contain more coarse particles, and consequently is represented by moisture-penetrometer-reading lines in progressively lower moisture ranges. However, a soil may be coarse enough to be represented by a moisture-penetrometer-reading line in a low moisture range but have as uniform grading as clay. It will then have a low density like clay. Again, it may be well graded in the coarser sizes, but deficient in fines small enough to lubricate the other grains and allow full compaction. Such uniform or poorly graded soils will be designated here as the *low density group*. Curves No. 2-b and 7-b on Figs. 2 and 3 are shown as examples of uniform and poorly graded members, respectively, of this group. They can only be densified by special methods and thus do not give any significant penetrometer readings.

It is apparent, then, that curve No. 1 in Figs. 2 and 3 represent an ideal grading for fine aggregate, or soil passing the No. 4 sieve. Such soil is dense, stable and yet has a relatively low permeability. By adding to this soil progressively increasing amounts of fines, or deflocculating electrolytes, or both, mixtures giving moisture-density curves 2, 3, *et seq.* in Fig. 3, when subjected to the standard compaction for which this discussion holds, will be produced. If, on the other hand, progressively increasing amounts of sand, silt-flocculating electrolytes or all of these, are added

to this ideal mix, the moisture-density curves will move to the left, toward and past curve No. 2-b. Thus, the density envelope and locus of optimums tend to rotate counter-clockwise, as the soil progressively loses the lubricating effect of its fines. At the same time, the moisture-density curves migrate downward with increasing fineness, as is indicated by comparing curves 2-b and 7-b with grain-size curves 2-b and 7-b for the same soils, on Fig. 2.

The foregoing discussion has shown that, for soils subject to a given compaction, a determination of three quantities will serve to classify the soil at least as well as does a grain-size distribution determination. Field and laboratory experience have indicated that the moisture-penetrometer-reading lines are also significant in soil classification. Soils represented by lines with numbers higher than 7 will definitely swell on wetting; soils numbered 1 to 5 will not. Between these lines there may be some slight swelling. Soils 1 to 5 give little settlement. Those numbered higher than 9 are too tough and lumpy to permit tamping, unless they have a crumb structure. Between 7 and 9, they can only be tamped at high moistures, unless they have a crumb structure (*i.e.*, flocculent). The properties of soils with numbers higher than 8 depend more on the chemical nature of the pore water than on the grain size. Diagrams numbered 8 and 9 in Fig. 2 illustrate this.

Keeping in mind the characteristics of the soils of the low density group, which were mentioned in the preceding section, it is concluded that a determination of moisture content, density and penetrometer reading for a soil tamped at a given compaction, will serve to classify that soil as to its suitability for use in a tamped earth structure. Since, for reasons that will not be discussed here, good practice requires that a soil be tamped at a moisture between the optimum and that at which failure under the wheels of the hauling units occurs, the determination of these three factors also indicates whether the soil is in a suitable state for use in the structure.

Procedure for field control

The relationships just discussed may be used as the basis for rapid field control. To apply it, test samples must be compacted to reproduce the effect of tamping in actual field operations. For the compaction of a 320-lb. per sq.in. sheepsfoot roller, for which the density contours in Fig. 2 were drawn, the standard Proctor method of tamping is satisfactory, except that a tamping hammer weighing 13 lb. and falling through 12 in. must be used instead of the standard 5½-lb. hammer. The test compaction cylinder is 4 in. in diameter and 5 in. high, with a removable collar. The dry density contours and corresponding moisture contents may be used to compute a series of wet densities and these in turn may be converted to gross weights of a test compaction cylinder plus soil in it tamped to these densities. Thus, instead of dry density contours, a series of contours of gross weight of test cylinder may be plotted over the moisture-penetrometer-reading diagrams, as shown in Fig. 4. The locus of optimums appears on this chart as on Fig. 2.

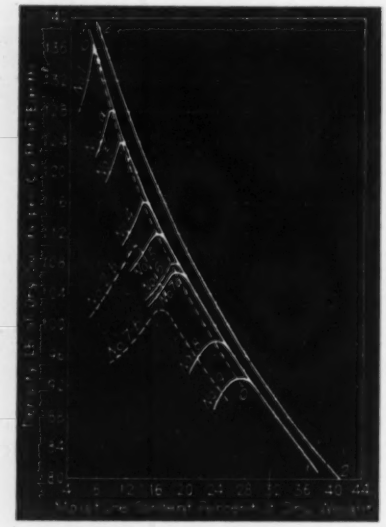


Fig. 3. Moisture-density diagrams for soils represented in Fig. 2.

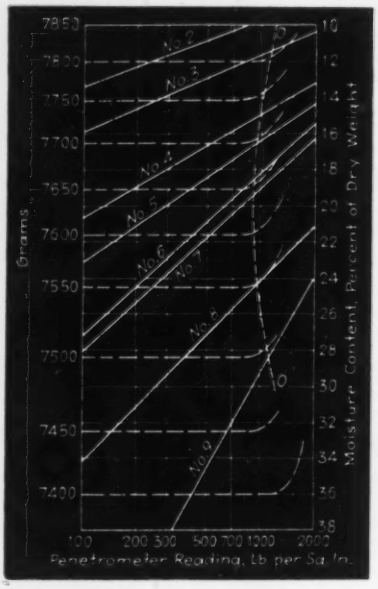


Fig. 4. Sample of field control chart in which contours represent the gross weight of the test compaction cylinder.

To apply the field control, screen the soil to be tested through a No. 4 sieve and tamp the fines in the test cylinder. Use 25 blows on each of three equal layers. Strike off the soil flush with the top of the cylinder and weigh it. Then take a penetrometer reading. Suppose the weight were 7,700 grams and the penetrometer reading 500 lb. per sq.in. Find the intersection of the vertical line in Fig. 4 representing 500 lb. per sq.in. with the dashed contour line representing 7,700 grams. The horizontal line passing through this point represents a moisture of 16.5 percent. The diagonal line passing through the point, line No. 4, is the moisture-penetrometer line for the soil tested. This line intersects line 0-0 at the optimum point for that soil, and the horizontal line passing through this intersection point represents 15.0 percent moisture. Line No. 4 may be found again on Fig. 2, and the dry densities corresponding to various moistures may be read from the contours. The optimum dry density to be expected, at 15.0 percent moisture, is 116 lb. per cu.ft., and the maximum dry density to which the soil can be compacted at its field moisture, 16.5 percent, with the tamping medium for which the control chart holds, is 113 lb. per cu.ft.

As a final step in the field procedure, a direct moisture determination should be run to check the estimated moisture, unless the soil is very fine or obviously well graded. The moisture may be run by weighing a soil sample, mixing it with alcohol and igniting it. This is repeated until no further loss of weight after burning is noted (two or three repetitions). If the moisture actually determined is greater than optimum and over 3 percent lower than that estimated from the chart, the soil belongs to the low density group. The greater the discrepancy, the poorer the grading. Also, in general, the lower the moisture corresponding to a given penetrometer reading, the coarser are the grains of the soil. Since soils of the low density group

generally show but small volume changes after tamping and high frictional stability, moisture control is often not required at all. On work where it is, special control charts must be made. For soil-cement mixes, or other materials with unusually high or low specific gravities, special control charts are also necessary.

Control by these charts, and also the degree of tamping, may be checked by samples cut from the tamped earth. For speed and convenience, these can be taken out with a pick in irregular chunks and their density determined by protecting them with paraffin and weighing in air and water. To correct for the paraffin, a specific gravity of 0.85 may be used. The dry unit weight of fine aggregate (minus-four-mesh) may be obtained from the dry unit weight of the soil mix, W_t, knowing the specific gravity of grains of coarse aggregate, S (this may be estimated knowing the rock in the coarse aggregate, as 2.5 for chert, 2.7 for limestone and sandstone, etc.), the percentage of coarse aggregate by dry weight of total mix, P, and the percentage of fine aggregate, p, using the formula

$$W_f = \frac{62.4\, S\, p\, W_t}{62.4\, S - P W_t}$$

Application in planning

Frequently it is required that material be placed at certain moistures and compacted to a certain minimum density. It then is of value in planning operations to know just what the moisture in proposed borrowpit areas is at a given time, and what densities the tamping equipment available would give. In getting such information a chart such as shown in Fig. 5 is useful. This chart holds for the standard method of test, tamping with a 5½-lb. drop hammer. Such compaction represents that of light traffic, or slightly more than that of a 150-lb. per sq.in. sheepsfoot roller. The density contours may be replaced by contours of gross weight of the tamping cylinder used in the field, plus earth tamped to these densities. Note that for all soils, the optimum points (line 0-0 in Fig. 5) are found at approximately a penetrometer reading of 400 lb. per sq.in.

All that is necessary to check the material is to pass it through a No. 4 sieve, compact the fines in a test cylinder, strike the compacted soil off level with the top of the cylinder, and obtain the gross weight. Then take a penetrometer reading. If this is less than 400 lb. per sq.in., the material has a moisture greater than the optimum. If the reading is greater, the moisture content is lower than the optimum. If the soil is very sandy, an actual moisture determination should be run to check the moisture found from the control chart. If the moisture actually run does not check, another control chart for uniformly graded materials should be used. Checks on moisture and density should be rather close if the soil tested is at optimum moisture or higher. If the moisture is lower than optimum, the checks are not so close, and on clays at very low moistures, they are often quite far off, due to the effect of lumps in the clay.

When a sheepsfoot roller weighing about 300 lb. per sq.in. is to be used, Fig. 2 would be the proper control chart. Here, optimum moisture is represented by a penetrometer reading of 1,000 lb. per sq.in. Similar charts can be prepared on the basis of actual experience for other tamping equipment.

Prospecting for borrowpits

Material taken from auger borings may be tamped, weighed and tested with the penetrometer. Suppose the point of Fig. 5 formed by the intersection of the weight contour and the penetrometer reading obtained in such a test lies seven-tenths of the distance between lines A-4.0 and A-5.0 on the control chart. Then the material would tentatively be classified as A-4.7. If the material tested is very sandy, this classification should be checked by a direct moisture determination. If this checks the moisture read on the control chart, the classification is correct. If the moisture determined is over 2 percent lower than that read on the chart, and greater than optimum moisture, the soil belongs to the low density group of poorly graded sands and silts. With similar control charts available for soils of this group, the soil could be reclassified, say to B-4.7, or if half way between the A group of soils and the B group, to .5B-4.7. In this way, materials can be grouped so that a very few composite samples are representative of all soils encountered in the borings. Thus the necessity is avoided of shipping and performing laboratory tests on numerous similar samples. This method of classification is difficult to use with clayey materials at moistures lower than optimum, as the soils become lumpy and the densities reflect the void spaces between lumps.

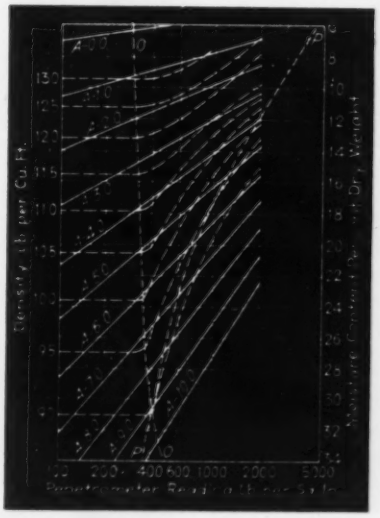


Fig. 5. Relation between moisture, penetrometer reading and density for compaction with a 5½-lb. hammer.

Specifications

Obviously, specifications vary according to the methods of design. If the materials are to be located which must conform to standard design, the specifications ordinarily call for materials having certain Atterberg limits, moisture equivalents and grain-size distributions. This might be called *design by comparison*. If the design is made to conform to available materials, it is usually necessary to determine it from analyses based on laboratory determinations of factors indicating compressibility, internal friction, etc. This is considered as *design by analysis*.

If design by comparison is used, an addition may be made to such a control chart as Fig. 5 whereby the specification factors may be approximated in a few minutes. It would take at least several hours with considerable equipment to run them directly. The method will be explained by an example. Suppose a soil sample, as tamped with a 5½-lb. drop hammer, showed a moisture of 16.2 percent, a penetrometer reading of 500 lb. per sq.in., and a dry density of 110 lb. per cu.ft. Using Fig. 5, this material would be classified as A-4.0. From the point of intersection of line A-4.0 and line 0-0, the optimum moisture is found to be 17.8 percent. With this type of compaction (but not with any other), the optimum moisture may be considered as an approximation

of the plastic limit. Line P-P indicates roughly the plasticity index. It crosses line A-4.0 at an ordinate of 12.0. The liquid limit is the sum of the plastic limit and the plasticity index, or 17.8 + 12.0 = 29.8. Since there is very little difference between the moisture - penetrometer - reading lines for the compaction of a 5½-lb. drop hammer and for that of a 13-lb. hammer, consider this same soil to be represented on Fig. 2 by line No. 4. Then the grain-size distribution is indicated by curve No. 4 on the right-hand side of the figure, and the material contains 73 percent sand, 11 percent silt and 16 percent clay.

Lines similar to 0-0 and P-P on Fig. 5 can be drawn to approximate variations of moisture equivalents and shrinkage constants. It should be emphasized that separate control charts are required for soils of the low density groups, and that the sandier the soil, the greater are the errors in approximations given by the charts.

When design by analysis is used, the soils tested can be identified by the proposed classification. It is possible to show, again with considerable approximation, contours similar to the density contours of Fig. 5, but representing lines of equal coefficient of internal friction, permeability, etc. Therefore, the proposed field control gives, with a rapid and simple test, an identification of the soil and of its moisture content, with reference to the design requirements.

Soil stabilization

Suppose that a material is required for a stabilized road base, with a plasticity index of 8 or less, a liquid limit of 25 or less, and a grain-size distribution as shown below.

U. S. Standard Sieve size	Percent passing
1 in.	100
¾ in.	85 to 100
No. 4	55 to 85
No. 10	40 to 65
No. 40	25 to 50
No. 200	10 to 25

On Fig. 5, a line drawn two-tenths of the distance from line A-2.0 to A-3.0 (Class A-2.2), intersects line P-P at an ordinate of 8.0, and line 0-0 at 12.5. Therefore material of this class has a plastic limit of 8.0 and a liquid limit of 20.5. Materials represented by line A-2.2 or with lower numbers conform to the limit specifications, and materials with higher classification numbers do not. Thus, a determination of density, penetrometer reading and moisture content on material passed through the No. 4 sieve check these specification requirements on the fines. If the actual moisture determination is more than 2 percent lower than that read from the chart, the material is poorly graded and requires addition of fines, or it contains grains with specific gravities outside the limits of 2.63 to 2.8. In the latter case, it is only necessary to apply a simple arithmetical correction to the density contours.

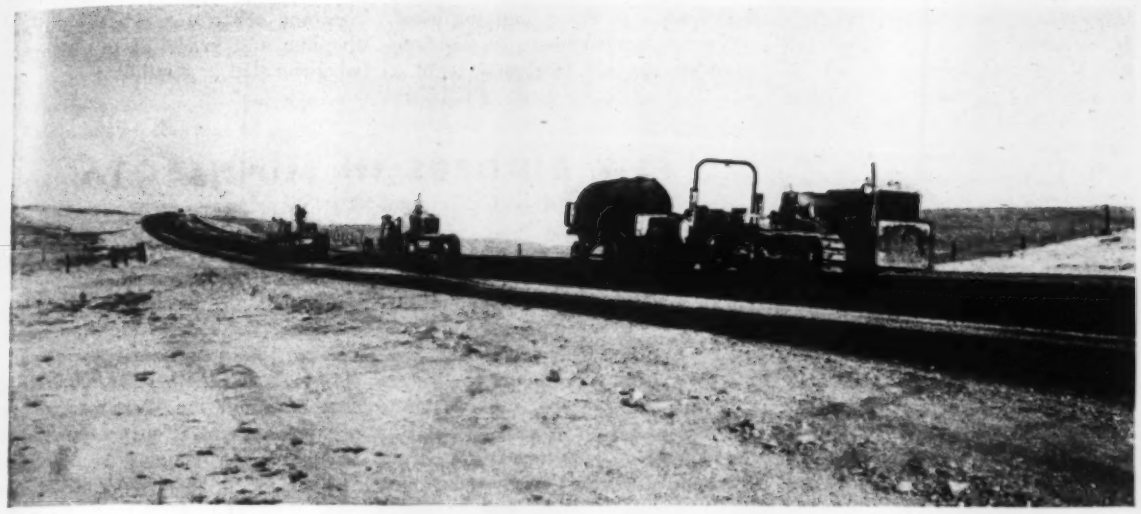
U. S. Standard Sieve No.	Approximate Percentages Passing Sieve Sizes Listed		
	Fine Aggregate	55 per cent Passing No. 4 Sieve	85 percent Passing No. 4
4	100	55	85
10	80	44	68
40	50	28	43
200	20	11	17

Now consider line A-2.2. When this line is referred to Fig. 2, it falls three-tenths of the distance from line No. 1 to line No. 4, on the left-hand side of the figure. If a curve is sketched on the right-hand side of the figure, three-tenths of the distance from curve No. 1 to curve No. 4, an approximation of the grain-size distribution of the minus-four-mesh (fine aggregate) sample is obtained. Since we are considering specifications that require a material of which 55 to 85 percent passes the No. 4 sieve, this grain-size distribution must be corrected to give percentage of a total sample conforming to these limits. The accompanying table shows the grain-size distributions for line A-2.2, with the limiting proportions of coarse aggregate. It is apparent that line A-2.2 represents an approximate limit for fine aggregate which meets the specifications given. On the basis of this fact, a method can be devised for checking these specifications in a few minutes in the field, without any elaborate equipment or specially trained personnel. Fig. 5 indicates that the dry density of the fine aggregate represented by line A-2.2 when compacted at optimum moisture is 122 lb. per cu.ft. This dry density can be replaced by the gross weight of tamping cylinder plus tamped soil. Hence, any material passing a No. 4 sieve, tamped in the test cylinder and weighed, which gives a gross weight corresponding to 122 lb. per cu.ft. or more, will fulfill the specifications provided the grading of coarse aggregate is as specified. Grading of coarse aggregate can be checked roughly in the field by hand sieves, disregarding the small effect of surface moisture on the stones.

Conclusion

The proposed control method, which is merely a revision of the Proctor system, permits the identification of the soil in both class and state. It furnishes a classification system which shows gradation, and eliminates border-line cases in which a soil could about as easily be put in one class as another. Since the properties of a soil vary with so many conditions that it is often impossible to get the same result twice on the same sample without elaborate controls of temperature, humidity, and other factors, the method is at least as accurate as many standard tests. When used with contours of soil factors determined under nearly ideal laboratory conditions, possibly more accurate results are obtained with the control charts than with direct determinations of the same factors in a field laboratory. The methods given here eliminate the tedious determinations of moisture-density curves for every material encountered. They also eliminate the time-consuming direct moisture determination on clays, with the chance of error in that determination due to faulty temperature control. They allow for the effect of the chemical composition of the pore water, which must be neglected in any conclusions made solely from determinations of grain-size distribution. Finally, they make it possible to furnish specifications which can be checked on the spot, rapidly and without specialized personnel.

The use of these methods to approximate grain size distribution or design constants is complicated by physico-chemical and other factors, and is not recommended without preliminary laboratory tests and later check tests. No claim of universal validity is made for these methods, but they have been applied successfully under sufficiently diverse conditions to indicate that they have a wide range of applicability.



Road mixer and graders at work laying the surfacing on a new stretch of U. S. 30 west of Cheyenne.

Roads Under War Restrictions—II

Continuing the sampling of the effects of war restrictions on the operations of the state highway departments begun in the issue of October 8, the editors of *Engineering News-Record* give below summaries of their discussions with state highway engineers in Minnesota, Iowa and Nebraska.

In the reports from Ohio, Michigan and Wisconsin, which were published in the issue of October 8, p. 484, it was found that shortages of materials for bridge work and the destructive effect of war-induced traffic were problems in Mid-West states where the concentration of war industries is high. Farther west, as will be seen in the following reports, shortage of road oil is a major problem.

SHORTAGES COMING IN WYOMING

Frank Kelso, superintendent of highways in Wyoming, has the department in excellent shape, as far as equipment and materials are concerned, to meet the present emergency. Loss of men and continuing drop in revenues, however, spell trouble for the future. Four years ago Kelso started to replace all old equipment owned by the state. Trucks and autos were traded in after they had gone 50,000 miles, a practice that cut repair bills $50,000 a year. Graders and snowplows were rebuilt if feasible, otherwise were replaced. As a result all equipment is now in excellent shape, though it is somewhat short in quantity, as this year's planned purchases, which never materialized, were necessary to bring the maintenance fleet up to full strength. Until recently there were plenty of mechanics in the maintenance division to keep the equipment in top-notch repair, but the armed services and war plants are now cutting into the forces.

Another far-sighted move by Mr. Kelso was anticipating the shortage in road oils. Wyoming, a large oil-producing state, was exempted in the oil-freeze order of last summer. Plenty of oil was available at the refineries, so the department placed 500,000 gal. in storage in tanks scattered throughout the state. Then another million gallons was purchased and immediately mixed with aggregate and stored in windrows on abandoned stretches of roads.

Normally the department receives about six million dollars annually, half of it from gas tax. So far this year gas tax collections are 31 percent below those of corresponding date last year. Tourist traffic, an important contributor to the gas tax, fell way off this summer. In Yellowstone Park, this season's travel was only 29 percent of last year.

Maintenance expenditures run about $800,000 per year, including equipment rental and depreciation. In normal times the maintenance division carries a permanent crew of 30 foremen and 130 men on an annual salary basis, about one man for every 25 miles of the 4,000-mile state highway system. As the season opens up, more men are added to the maintenance crews. This year the extra labor was unavailable, so the division is operating with a shortage of 200 men. The department believes in conserving manpower, so it operates its own screening plants and has 15 mechanical loaders for loading the trucks. This mechanization of all operations is paying dividends in the current shortage of labor.

The department built 12 new modern brick maintenance shops in the past three years, which are also important in keeping equipment in repair with a minimum of manpower. This gives the state a total of 27 maintenance stations, but four more are needed to complete the set-up.

At present the maintenance division is about 30 days behind the season's schedule because of lack of men and the time taken out to store the oil in tanks and windrows.

Wyoming is in the heavy snow belt, but the highway department is well equipped to handle snow. All new roads have been built to a wide surface with flat borrowpits. The grade is oiled almost full width, and the seal coat is carried out into the shoulders. This design helps the wind keep the road clear of snow and greatly simplifies the snow removal, for there is plenty of space in the flat ditches to pile the snow. Removal is by truck blades, patrol graders and nine rotaries, the latter used mainly in the mountains. Coal slack, of which there are great quantities in the state, is mixed with sand and stockpiled for ice control.

Many men gone

The department's regular personnel has been heavily depleted by calls to the armed services and to war industries. Headquarters are practically deserted. Every designer and draftsman still on duty has been sent out to the field. Mr. Kelso is carrying on with a couple of office aids—his chief engineer, Charles Seifried, president of the Western States Highway Officials Ass'n, is on indefinite leave of absence because of illness. Every former district engineer has gone into the army, and the five former districts have been combined into three. There are now only nine engineers and two instrumentmen left in the field. So far the five maintenance districts have been left intact.

Construction

Already this year there have been 26 construction projects completed, including some carried over from last year. Eight more are to be finished. Contractors do not hestitate to bid on Wyoming work, and plenty of bids have been received on every project. Possibly the availability of contractors in the state is because there have been few camps or war industries to build.

Principal projects now under construction, all on U. S. Route 30, the main transcontinental highway across the southern end of the state, are: 15 miles of relocation just west of Cheyenne; 12 miles near Medicine Bow; and 6 miles at Green River.

In the wide-open spaces of Wyoming, land is so cheap that the usual procedure in road reconstruction is to abandon the old road and build a new one off to one side, improving the line and grade of the highway wherever that is possible.

FEW BIDDERS IN MINNESOTA

M. J. Hoffmann, Commissioner of the Minnesota State Highway Department, interrupted the consideration of bids following a recent highway letting to discuss problems that the war has brought to his department. Contract lettings are one of those problems. Bids on jobs advertised by the highway department are few, there being no bids received on one of the jobs for which bids were opened on the day the highway department was visited; and bids run as much as 30 percent above the engineers' estimates, which in themselves have been made liberal because of the uncertainties surrounding materials supplies and because of the high turnover of labor. Contractors have already lost many of their best men, a loss that directly affects their bid prices and operations.

Loss of men from the highway department to the Army and to war industries, and the many readjustments that these losses and the curtailment of construction are causing in the department, are other problems faced by Commissioner Hoffmann. The highway department now has 226 men in uniform, and of these 129 left from the engineering department. Realizing that skilled men are badly needed in war industries, the department about a year ago established a policy of releasing to war industries all men who do not have to be replaced by hiring other men of like training.

Restrictions on construction

Much construction work has been shut down under the restrictions now in force. This curtailment will release for other assignments project engineers with some 12 to 25 years of service in the department. Wherever possible, these men are being placed in inside jobs vacated by men going into service or shifting into war work. As many as possible will be put on postwar planning to provide these valued men with work until construction can be resumed.

Postwar planning and the building up of a reserve fund with which to do postwar work are getting more than lip service in Minnesota. During the last fiscal year, which ended June 30, $3,000,000 of surplus highway funds was put into a postwar reserve fund, and at least another $3,000,000 is earmarked for the same reserve out of the current year's anticipated revenues.

Highway income

During the early part of the calendar year, the state had little decline in its highway income, but June revenues declined about 6 percent and July income about 12 percent.

The department carried over into the present calendar year $4,000,000 of work. It had scheduled over $11,000,000 in improvements to be placed under contract in 1942, but of course this entire program had to be withdrawn and revised upon a defense-necessity basis when wartime restrictions became effective. Present accumulated federal-aid allotments to the state's credit are around $5,000,000. Work now in hand includes a considerable amount of access roads to war plants, some of which is 100 percent federally financed work, entirely off the trunk highway system, and some of which is on the federal-aid system, the cost being shared on a 50-50 federal-state basis.

Still other work includes construction on the state system, essential at this time to protect the investment already made in recently constructed grades and bases, or in roads over which there is heavy war traffic. These roads will break up unless work is done on them. The amount of this work in the program for the new fiscal year is about 143 miles of highway, costing $2,900,000. Plant access road mileage off the state trunk system will be about 19 miles, costing $450,000.

Highway maintenance

Maintenance work has not yet been especially stepped up to meet the decline in new construction. Oiling, however, has been increased due to the department's inability to go ahead

with normal state construction work.

What effect curtailment of automobile traffic is to have on future highway maintenance is not yet known. The state has no shortage of gasoline, but there has been considerable voluntary curtailment of travel to save rubber.

Conservation of materials

The Minnesota Highway Department has undertaken in every possible manner to comply with the spirit as well as the letter of federal requirements for the conservation of critical materials needed in the war effort. Substitutions of steel and similar materials have been made wherever possible in the development of plans and specifications for new projects. And substitutions have been made wherever feasible in work already underway. Bridge steel, salvaged from old bridges, is being used wherever practicable in the construction of other small bridges. Where salvage steel is not available, bridges, even including smaller structures required on access roads, have been built of timber, where steel and concrete would have been used under normal conditions.

The department was in a relatively favorable position in that it had a considerable number of smaller types of culverts and culvert pipe on hand at the time emergency restrictions became effective. This available supply has eased the department's drainage problem to a considerable extent. But beyond this, non-reinforced-concrete pipe is now being used in the place of reinforced-concrete pipe for smaller-sized culverts. Likewise creosoted timber box culverts are being used to replace reinforced concrete.

Unreinforced concrete pavement

An outstanding example of the Minnesota Highway Department's efforts to eliminate critical materials is perhaps best reflected in its revision of specifications for concrete pavement. Under pre-war conditions normal specifications for a two-lane concrete pavement 22 ft. wide called for reinforced slab 9 in. thick on the outer edges with a 4-ft. taper to a 7-in. slab. Under re-drawn emergency specifications, reinforcing steel is eliminated entirely with the exception of dowel bars in lateral expansion joints which thus far have been obtained from stock on hand or salvage. The slab now used, in effect, applies the 9-7-9 formula to each lane instead of to the full width of pavement. The non-reinforced 22-ft. concrete slab now being laid, wherever concrete pavement is justified by war needs, is 9-in. thick on the outer edge with a 2-ft. taper and has a 9-in. thickened edge on the center line. Thus each longitudinal section, 11 ft. wide, follows the 9-7-9 formula except that the tapers, from center line outward and from outer edge centerward, are accomplished within two feet instead of four feet of lateral distance.

In order to eliminate the necessity for steel in the mortising of the longitudinal or center-line joint, adjacent sections are built separately according to a tongue-and-groove design with the groove section being cast in place in the first form and the slab for the adjacent lane poured after the center forms have been removed. The last slab poured thus fills in the groove at the center-line joint, providing a load-transfer joint which will lessen the likelihood of faulting.

Thus far the Minnesota department has experienced no inability to obtain delivery of bituminous materials ordered, but it has restricted its orders to a basis of immediate necessity, and in some instances has relaxed its specifications to permit the substitution of grades of oil more readily obtainable and less critical in classification as to war needs.

LACK OF ROAD OIL IN NEBRASKA

Contractors were unable to bid much Nebraska state highway work this season because the oil companies refused to quote them prices. Nebraska was caught in the oil-freeze order of last June, then the ban was lifted, but the resulting confusion upset all normal construction schedules. Finally, the oil refineries allocated a certain quantity of oil to the state highway department, most of which was required for maintenance schedules, though there was some available for construction. By the end of August the allocations were exhausted, which stopped all maintenance and all but a few construction projects vital to the war effort. Even on some access roads to war projects it became necessary to inaugurate a system under which the army furnished the materials to contractors engaged by the state highway department.

State builds access roads

Most new construction this year has been confined to access roads. In some cases the state did not wait for federal access-road funds, but cooperated with the war effort to the extent of building such roads entirely with state funds. As explained by Wardner G. Scott, state engineer and the head of the Nebraska Department of Roads and Irrigation, state officials, backed by public opinion, considered it a patriotic duty to build certain access roads as an aid to getting important war plants into production at the earliest moment.

A troublesome shortage in maintenance equipment has developed because of two reasons: first, normal replacement of worn-out equipment has been impossible; and second, the equipment has been used for construction around war plants and for completion of several projects under "stage construction" left over from last year that would normally be cleaned up by contract. However, all equipment is in fine shape, for up to the present time there have been plenty of mechanics available for repair work.

In fact, the maintenance division has not suffered greatly from loss of men in any classification. In some parts of the state, especially in the thinly populated sections, maintenance crews are sometimes short of men but not enough to hamper the program.

At the Lincoln headquarters more than half of the office and engineering personnel have left for the armed services or war industries. Those leaving for military service are granted full leave of absence but the others give up all civil service rights when they leave.

Revenues hold up

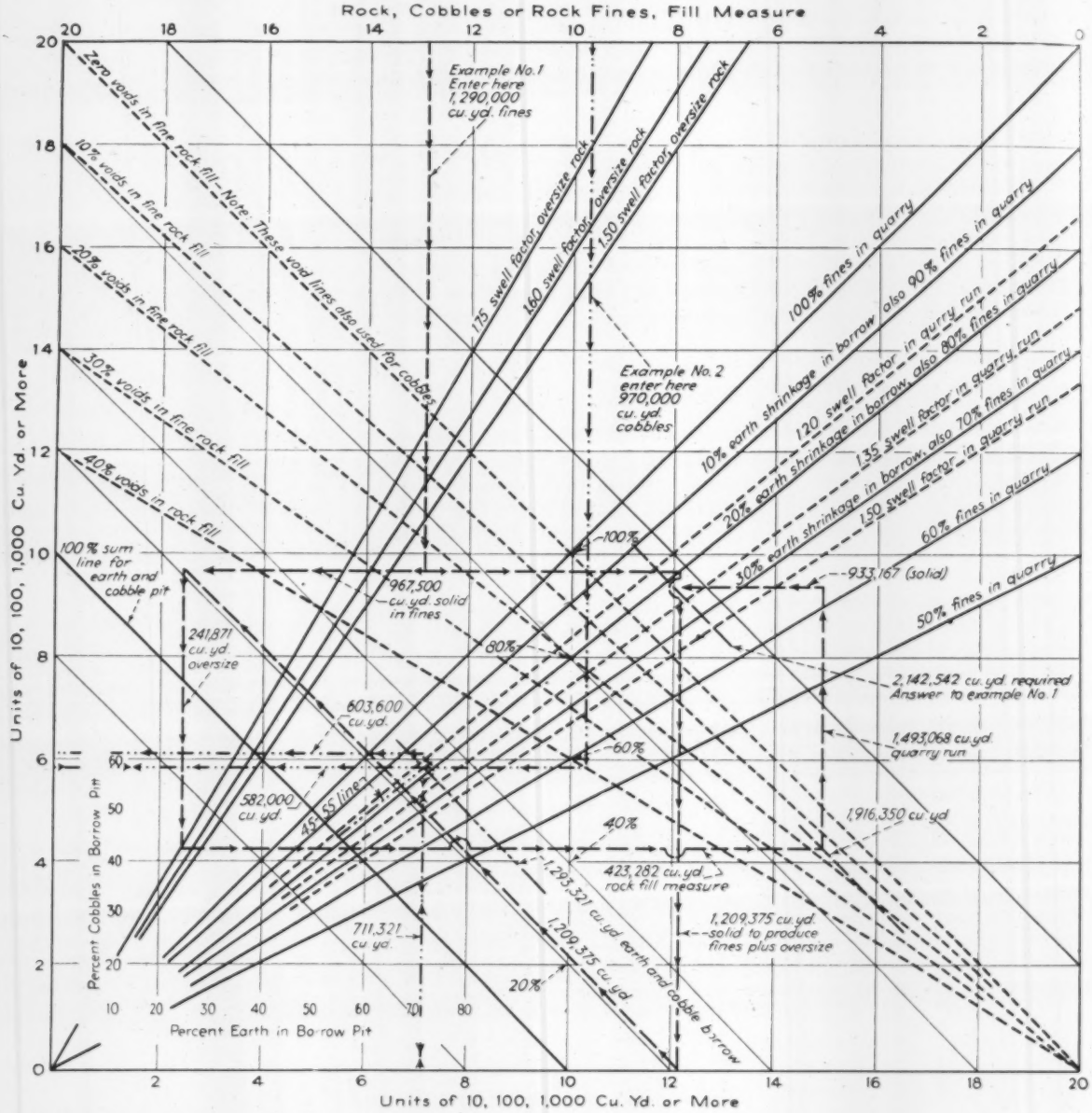
Gas tax revenues this year are about 9½ percent below those of 1941 for the same period. An influx of war industries has largely offset the drop in normal travel.

Nebraska spends a larger proportion of its highway funds on maintenance than do most states. Out of $5,500,000 income in 1941, about $3,000,000 went for maintenance.

Solving Quantities in Excavation and Fil

Ben F. Powell
Bureau of Reclamation, Denver, Colo.

DURING the design of zoned earth and rockfill dams it is usually necessary to make several solutions involving assumed ratios of separation of the material with which the structure is to be built. The arithmetic of these problems is not involved but these solutions consume enough time to preclude any rapid answer to a hurried change in design, especially if the answer is required in the conference room. The diagram accompany-


Rock, Cobbles or Rock Fines, Fill Measure
Units of 10, 100, 1,000 Cu. Yd. or More
Zero voids in fine rock fill—Note: These void lines also used for cobbles
10% voids in fine rock fill
20% voids in fine rock fill
30% voids in fine rock fill
40% voids in rock fill
100% sum line for earth and cobble pit
Example No. 1 Enter here 1,290,000 cu. yd. fines
Example No. 2 enter here 970,000 cu. yd. cobbles
175 swell factor, oversize rock
180 swell factor, oversize rock
1.50 swell factor oversize rock
100% fines in quarry
10% earth shrinkage in borrow also 90% fines in quarry
1.20 swell factor in quarry run
20% earth shrinkage in borrow, also 80% fines in quarry
1.35 swell factor in quarry run
30% earth shrinkage in borrow, also 70% fines in quarry
1.50 swell factor in quarry run
60% fines in quarry
50% fines in quarry
967,500 cu. yd. solid in fines
241,871 cu. yd. oversize
603,600 cu. yd.
582,000 cu. yd.
45° SS line
711,321 cu. yd.
1,293,321 cu. yd. earth and cobble borrow
1,209,375 cu. yd.
423,282 cu. yd. rock fill measure
1,209,375 cu. yd. solid to produce fines plus oversize
933,167 (solid)
2,142,542 cu. yd. required Answer to example No. 1
1,493,068 cu. yd. quarry run
1,916,350 cu. yd.
100%
80%
60%
40%
20%
Percent Cobbles in Borrow Pit
Percent Earth in Borrow Pit

Typical Equation—Quarry required (solid measure) =

$$\left\{\frac{\text{Cu.yd. fines} \times \text{percent solid}}{\text{Percent of fines in quarry}} + \frac{\text{(Total rock-fine rock)} - \left[\text{(Swell factor of oversize)} \times \left(\frac{\text{(Cu.yd. fines} \times \text{percent solid}}{\text{(Percent of fines in quarry)}} - \text{Fines} \times \text{percent solid)}\right)\right]}{\frac{\text{Quarry run (loose measure)}}{\text{Quarry run (solid measure)}}}\right.$$

ing this article will be found of great assistance, not only for leisurely design but also for the rapid solution of last-minute changes in design.

The diagram is simple in construction, being a combination of a proportion and a summation chart in alternate. The solution of these two problems give a clear understanding of the possibilities of the chart.

Example No. 1. Solid rock borrow

The required fill contains 1,290,000 cu.yd. of fine rock and 1,916,350 cu.yd. of rock other than fines. This 1,916,350 cu.yd. is to be made up of oversize from screening of fines and quarry run. The swell factor for oversize from screening is assumed to be 1.75; swell factor for quarry run is assumed to be 1.60. The percent of fines in quarry is assumed to be 80 percent. The voids in the fine rock are 25 percent of fill measure.

To find amount of excavation in quarry:

Enter top of chart at 1,290,000 cu.yd. and descend to 25 percent voids line. This shows that there are 967,500 cu.yd. of solid measure in 1,290,000 cu.yd. of fines (left scale).

Proceeding to the right on 967,500 line to 80 percent fines in quarry gives 1,209,375 cu.yd. (at bottom of page) and is the amount of fines and oversize necessary to get 1,290,000 cu.yd. of fines.

Follow the 1,209,000-cu.yd. sum line diagonally to the left and up to the 967,500 previously determined; read at bottom of chart 241,875 cu.yd. as solid volume of oversize.

The intersection of 241,875-cu.yd. line and 1.75 swell factor shows that the loose volume of 241,875 cu.yd. is 423,282 cu.yd. (left scale).

Following the 423,282 line to the right until the 1,916,350 sum line is reached, shows that 1,493,068 cu.yd. of quarry run will be needed to complete the job.

Since this 1,493,068 cu.yd. is fill measure this may be reduced to solid measure by intersecting the 1.60 quarry run swell line and reading 933,167 on left scale.

The intersection of 933,167 (left side) and 1,209,375 (bottom) previously found gives 2,142,542 cu.yd. as required borrow (solid measure).

Example No. 2. Cobble, earth borrow

Given: Volume of cobble fill equals 970,000 cu.yd.; voids in fill 40 percent. The earth and cobble borrow pit shows 45 percent cobbles (solid volume measure) and 55 percent earth (by volume). The shrinkage of earth from borrow to fill is 15 percent.

To find: Earth produced in screening for 970,000 cu.yd. of cobbles, volume of borrow required and earth fill produced.

Enter diagram at 970 cu.yd. at top and descend to the 40 percent voids line. On the left scale read 582,000 cu.yd., solid volume of cobbles.

Since the borrowpit is 55 percent earth and 45 percent cobbles, the volume of earth (borrow measure) is to be found on the bottom scale directly under the intersection of the 582,000 line and the 45-55 diagonal. The value is 711,321 cu.yd.

To ascertain the amount of fill produced by 711,321 cu.yd. of earth read 603,600 on left scale to correspond with 711,321 cu.yd. and 15 percent shrinkage.

The volume of borrowpit to produce 603,600 cu.yd. of earth fill and 970,000 cu.yd. of cobblefill is the sum line at the intersection of 582,000 (left side) and 711,321 (bottom), previously found, giving 1,293,321 cu.yd. as required borrow (pit measure).

Some Suggestions for Starting Water Softening Plants

When Charles P. Hoover, chemist at the Columbus, Ohio, filtration plant, was asked to prepare a paper for the recent conference of the American Water Works Association, this statement was made in the request: "In several cases lately, operators of water treatment plants have been disturbed by the problems that they have had to meet when the softening plant was built and the softened water put into distribution mains that for many years had carried water having different characteristics."

"My instructions", reports Mr. Hoover, "were to indicate what should be expected, and what general measures should be taken to correct the situation as well as to reduce the public clamor that results from new conditions. The term 'public clamor,' resulting from the introduction of softened water, came to me as a surprise," said Mr. Hoover. He pointed out that he had started many water softening plants, and the consumers' reaction has been almost always favorable, and in many instances response has been enthusiastic.

On the basis of past experience, therefore, he made these suggestions in connection with starting up a new water softening plant:

Do not tell the public ahead of time; it is better psychology to let them discover that water of a different quality is being distributed themselves.

Do not recarbonate for several weeks. Without recarbonation, the softened water is unstable, and lays down enough protective scale to coat or "whitewash" the interior of the mains. This can be determined by putting in a few test pipes; it is advisable to have these test sections of pipe at the plant and also at the far ends of the distribution system.

Do not use hexametaphosphate or other phosphates at the start, as they prevent the accomplishment of protectively coating or "liming up" the mains. Their use may also loosen up rust deposits already in the mains, and sometimes release green deposits of copper from meters.

If the water is oxygen-free well water, keep it as free from oxygen as possible. Do not aerate unless there is some unusual or special reason.

Use lime and aluminum sulfate

Enough lime should be used to precipitate as much magnesium as possible, even though the treated water contains from 20 to 30 ppm. of caustic alkalinity. Undertreatment with lime precipitates the magnesium only partially and its presence may later make its appearance as magnesium silicate in heating coils.

Addition of aluminum sulfate facilitates magesium removal and should be used along with the lime and soda ash. Magnesium is an important element in scale produced from lime-softened water. It is found in the scale, and its presence may affect the nature of the scale produced. It is also conceivable that the presence of silica in scale has an effect on its nature.

Mobile Power Unit for Emergency Needs

PART OF THE GENERAL PLAN of preparedness for disasters such as earthquakes or extensive fires in the area served by the East Bay Municipal Utility District, Oakland, Calif., is a trailer-mounted electric power plant whose generator has sufficient capacity to drive motors as large as 75 hp. In the event of a prolonged power interruption at a pumping or filtration plant, the trailer can be towed to the location where emergency power is needed.

The main unit is a 60-kw. 480-volt 3-phase 60-cycle generator driven by a direct-coupled 90-hp. gasoline engine. A centrifugal governor prevents variations of more than 2 percent of the prescribed generator speed. A 2-kw. exciter, mounted over the main generator, is driven by a triple V-belt from the main shaft. Automatic devices shut down the unit in the event of excessively high water temperature or low lubricating oil pressure. A 9-kva. transformer supplies power for operating 220-volt motors up to 10-hp. and a 1-kva. transformer makes available 110-volt current for lighting and small equipment.

Arrangement of units

A switchboard panel is mounted on vibration dampeners and supported on a bracket bolted to the rear of the engine and extending over the coupling. This makes it possible to remove the engine-generator unit from the trailer without disconnecting instruments or controls. The power disconnecting switches, transformers, compensator, terminal board and three-compartment cable reels are located on the raised floor over the front axle. All accessories, controls and instruments to be operated or observed are mounted facing the right-hand side of the vehicle; thus the trailer can be parked near the curb headed in the direction of traffic with controls on the sidewalk side. Most of the district's pumping plants within the capacity of this unit have motors that normally start directly off the line without use of compensators. A compensator was therefore provided for easier starting of motors of 50-hp. capacity or less.

The main trailer frame is built principally of 8-in. steel channels with welded joints. A vertical offset at the front end forms a "gooseneck" over the front axle to permit a shorter turning radius and a wider frame at the rear. The engine-generator unit, which can be removed integrally with the subframe on which it is mounted, is a separate assembly supported practically under its center of gravity on a cross-member welded to the bottom of the main frame a short distance ahead of the rear axle. A large pin welded to the generator end of the subframe engages a bushed hole in a cross-member of the main trailer frame and takes up the off-balance load. This arrangement assures true alignment of the engine and generator even though the main frame should be deflected or distorted.

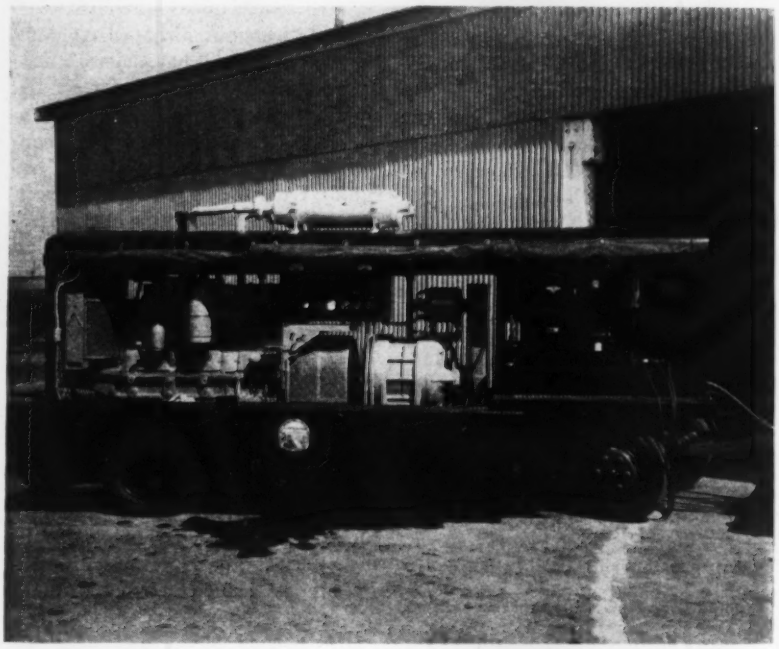
At the rear, 15-in. dual wheels equipped with vacuum-operated mechanical brakes are mounted on a tubular axle bolted to pads welded to the underside of the frame. Handbrakes are provided for parking.

The top, extending the full length of the trailer, is made of three pieces of No. 16-in. gage steel welded into a single sheet and rolled to the required shape. Light steel framing supports the top on six uprights arranged for easy removal. Canvas curtains are used to enclose the unit when it is idle.

Fuel for one day

Two rectangular, baffled fuel tanks are mounted, one on each side of the trailer frame, between the front and rear wheels. Combined capacity of the tanks is 240 gal., enough to supply the engine at full load for about 28 hours. Vacuum fuel feed lines enter each tank at both ends, making it possible to utilize full capacity even if the trailer is parked off level. Overall length of the trailer is about 17 ft.; the width is 7½ ft. The height is 7 ft. 1 in. exclusive of the mufflers mounted on the top. The total weight is 15,350 lb.

The unit was designed and built by the East Bay Municipal Utility District; J. S. Longwell, chief engineer and general manager. H. A. Knudsen, mechanical and electrical engineer, supervised design and L. F. Moullet, mechanical engineer, worked out details.



Complete power plant, trailer mounted, can supply energy for 75-hp. motor at pumping or filtration plants.

Grouting Checks Foundation Vibration

***Contents in Brief**—Vibrations set up by the compressors of a gas station in Wichita, Kan., caused serious trouble in the pile foundations of both the machines and the building in which they are housed. The vibrations were practically stopped by grouting the 50 ft. of sand through which the piles were driven. Application of grout under pressure was through solid wall pipes, perforated after driving, by an ingenious gun that shot bullets through the pipe at desired locations. The following is abstracted from an account in the Portland Cement Association booklet Concrete for Railways.*

POUNDING OF NINE COMPRESSORS in the gas compressor station of the Cities Service Gas Co., at Wichita, Kan., loosened the foundation piles upon which the machines rested and those under the building columns, and the surrounding soil, a condition that caused annoying and harmful vibration and settlement of the foundations. The building and compressor units, built and installed in sections from 1927 to 1932, rest on wood piles driven into a 50-ft. bed of river sand overlying shale. Groundwater level is 20 ft. below the surface, about 10 ft. below bottom of compressor foundations.

Vibrations became progressively worse, for as the piles loosened they permitted greater amplitude in foundation sway, which correspondingly increased the amount of vibration. Frequent resetting of the compressor units was necessary. Consolidation of the sand by injection of cement grout finally was adopted to stop the trouble. However, because of the size of the project (68x228 ft. in plan) and the unusual situation involved, special techniques had to be developed, including a determination of proportions and consistency of the grout, pressure to be applied, and the equipment to be used.

Extent of vibrations

The summations of vibrations from the nine units varied in intensity according to whether they were additive or subtractive. As the situation became worse, operation of the plant not only became expensive but hazardous and it was apparent that steps to reduce vibration to a minimum must be taken. What this minimum should be was not defined as it was generally agreed that even under stable conditions some vibration would occur.

A special recording meter was set up to record the magnitude, frequency and other characteristics of the vibrations. Before grouting operations started the chart showed a lateral movement as high as 0.1 in. each side of normal. After the job was completed the highest lateral movement recorded was 0.022 in., about one-fifth of that formerly obtained. Also, prior to start of work, a bucket of water placed on the ground 50 ft. outside the building was visibly agitated and workmen within the plant were annoyed by the continual shaking motion.

Before starting the main grouting job preliminary tests were made outside of the building along one of the walls. Cores were then taken in the grouted material at various distances up to 8 ft. from the injection point, which indicated that considerable cementation existed in the foundation soil. It was realized in the beginning that not all of the sand would be enveloped by the grout, but it was felt the process would consolidate the ground between the areas actually affected by the grout. Subsequent tests showed this presumption to be correct.

Driving and perforating pipe

All points of injection were inside the building, and spotting of the injection holes was determined by the location of the compressor units and connecting lines, other fixed equipment and structural members. In general, the holes were laid out in as even a pattern as possible, with a maximum distance between holes of 20 ft. At compressor ends of the units, where maximum weight concentration exists, the holes were much closer together. At each selected location a hole was drilled through the station floor and a piece of 6-in. pipe 3 ft. long was cemented in place. Then a 3-in. grouting pipe was jetted to the shale 50 ft. below, using a bentonite solution as the circulating

Fig. 1—Gun shooting steel bullets for perforating 3-in. grout pipe. The gun is lowered to desired location within grout pipe and is fired electrically.

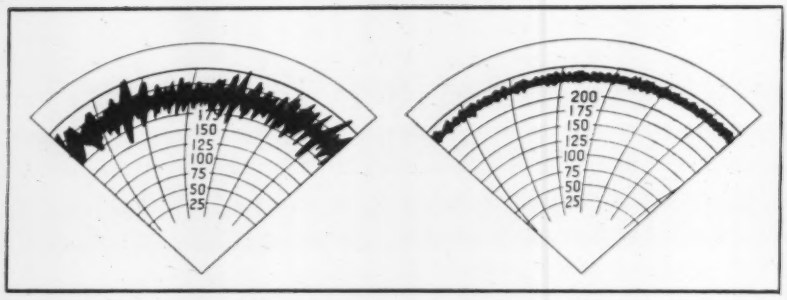


Fig. 2—Typical "before and after" charts of vibration amplitude in compressor foundations. Readings before consolidating the ground are at left.

fluid. When the 3-in. pipe had landed on the shale it was grouted in place.

The next operation was one of the most interesting of the entire project, that of perforating the solid wall injection pipe for admission of grout to the surrounding ground. A small gun designed by the grouting engineers to shoot $\frac{3}{8}$-in. steel bullets through the walls was lowered into the pipe. It was handled by cable to the desired depth and fired electrically. As many shots as desired could be fired at one run and at spacings as close together as $5\frac{3}{4}$ in., but due to the momentarily high force exerted at the instant of firing, the number of shots in one run was limited to five or less. During experiments in the laboratory under conditions similar to those on the job the bullets, after perforating the pipe, traveled as far as 18 in. into the soil.

Grouting procedure

The mixing and grouting equipment was set up outside of the compressor house, and three hose lines were run inside the plant to the point of grouting. One line delivered grout from the pump discharge, one was for returning excess grout to a sump at the pump, and one was a water line. These three lines were connected to a grout head, consisting of a manifold with a series of valves and gages, for attaching to the grouting pipe.

The grouting head was attached to the injection pipe and the perforations were cleaned out with a small charge of water. Neat cement slurry was used as grout and no attempt was made to control the weight of this slurry beyond keeping its weight less than 13 lb. per gal. Maximum allowable pressure was limited, in most instances, to 150 psi. by returning any excess grout to the sump. With this equipment the supply of grout was continuous and by returning the excess grout, plugging of lines was practically eliminated.

Pressure and rate of application of the grout were under control at all times by means of gages and valves at the grout head. In determining the maximum allowable pressure, consideration was given to depth, weight of compressor units, mats and other loads. This calculated value was somewhat less than actually maintained because allowance had not been made for the pressure drop through perforations in the grout pipe. Actually, pressures were permitted up to those at which the compressor units started to rise. Any such tendency was detected by constantly watching a group of levels placed on the main frames of the compressors adjacent to the injection points. As a further precaution, check levels were frequently taken by two levels and rods at various points. In this way it was possible to control vertical lifts to within a few thousandths of an inch.

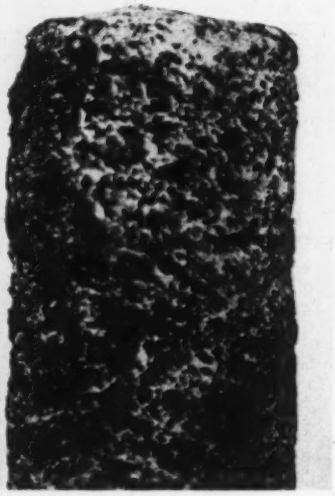


Fig. 3—Core sample shows excellent job of consolidating wet sand with cement grout. This core was taken 8 ft. from point of injection.

As soon as a pipe had been grouted to refusal at a desired depth the grout in this hole was left to harden, the grout head was transferred to the next point, and the process repeated. Since it was necessary to reperforate pipes at various depth zones more than once, a crew of men was employed to wash out the holes four to six hours after grouting. For this purpose several 10-ft. lengths of 1-in. round pipe were provided, having a 1x2-in. swage attached to the bottom, to belled out $2\frac{3}{4}$-in. diameter. This pipe was lowered below the zone to be treated and the cement grout was washed out by circulating clear water by means of an auxiliary pump.

Throughout the grouting operation the objective was to cause a slow permeation of the grout into the soil by means of a continuous pressure, which would neither produce lenses or pockets of hardened grout nor any violent disturbing action such as are often caused by injecting small intermittent batches of grout by pneumatic pressure. Much of the grouting was done in saturated material below groundwater level, the intention being to drive out this water as the grout permeated the soil.

In the first division of the work, that comprising two-thirds of the area round twin compressor units, 35 grout pipes were set, into which 10,584 sacks of portland cement were injected. On the second division, around single units, 20 grouting pipes were set and 3,743 sacks of portland cement were used. Following this, to insure complete grouting of certain areas where there was some doubt of the desired result, the hardened grout was drilled from 11 grouting pipes around compressor ends of the single units of the second division, the pipes were reperforated, and more grout was injected. In the first division 11 new holes were drilled between the various twin units, grouting pipes were set, and grout injected. Into these 22 holes were injected 2,789 sacks of cement, bringing the total for the entire job up to 17,116 sacks injected into 66 separate grouting holes through 4,279 perforations in the pipes. A total of 28 days was required for the job.

The grouting job was done by the Halliburton Pressure Grouting Corp., of Duncan, Okla., under the supervision of R. E. Moeller.

SPECIAL SECTION ON *War Buildings* OF 1942

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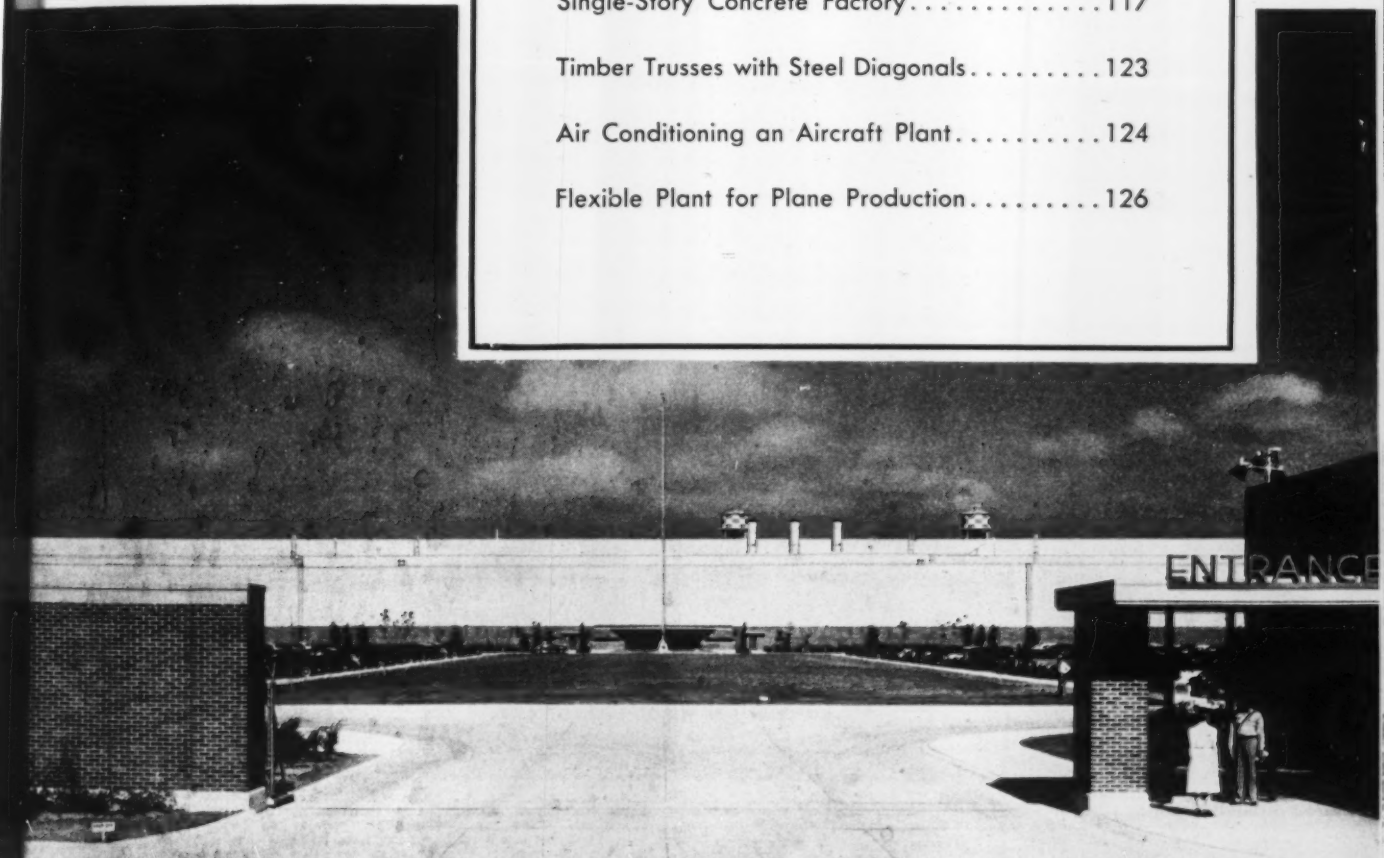
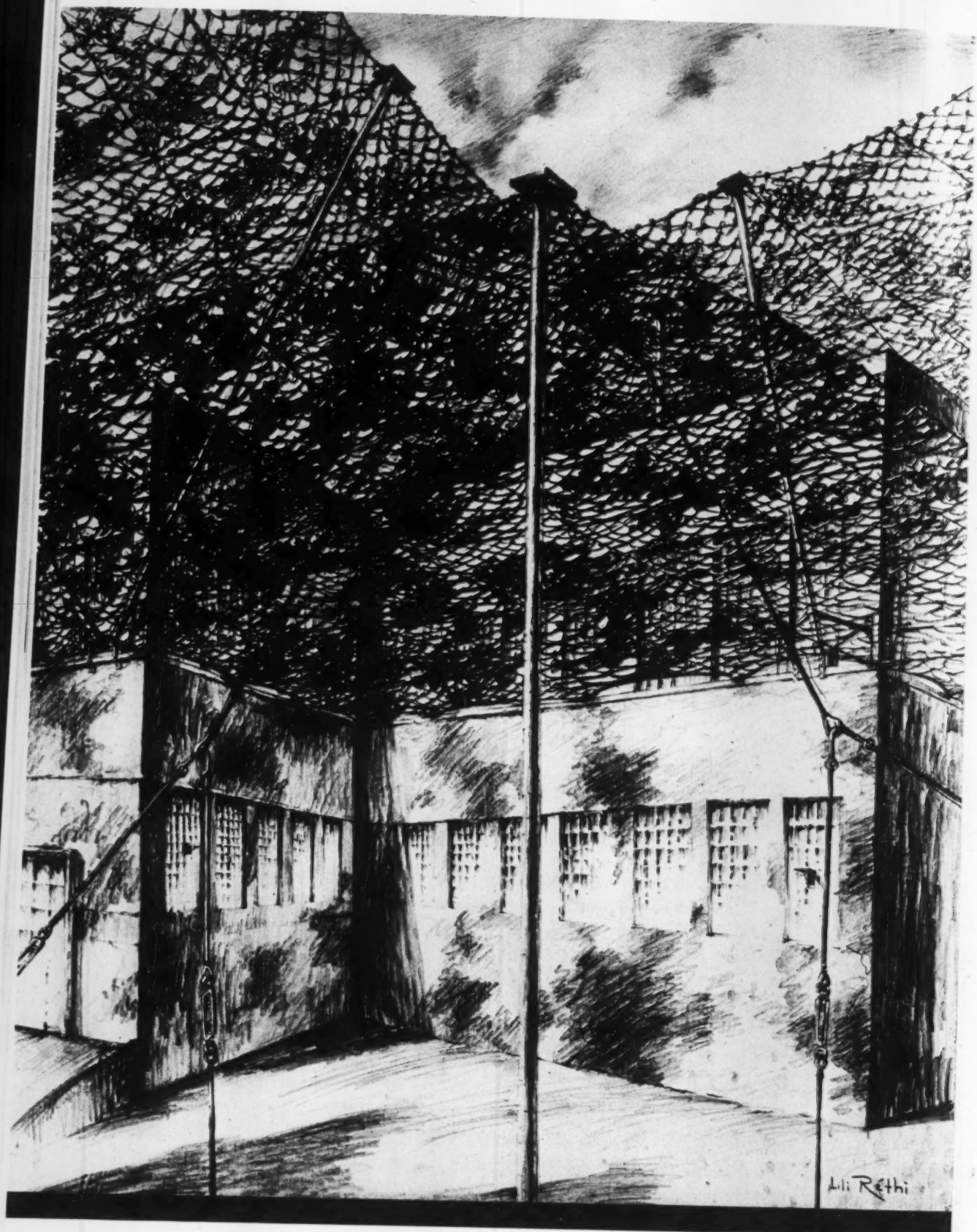




Camouflage design by B. F. Miller, Jr.

Camouflage nets, installed to hide some of the most vital of 1942's war buildings from unfriendly eyes, are symbolic of the unnatural conditions under which building design and construction have now to be carried on.

War Buildings Are Different

BUILDING DESIGNERS in 1942 were challenged with the task of getting along without many of their familiar materials or, in the best of circumstances, with greatly reduced amounts of them. The challenge existed because a period of scarcity never before had been faced in this country, and it came at a time when more and larger buildings had to be built than in any like period in history.

THAT THE challenge has been met in part, and that the buildings are now, or soon will be, a functioning part of America's war plant represents an accomplishment in which many have shared. Government officials, both civil and military, have altered requirements and specifications on a fast, emergency basis. Engineers and architects have exercised ingenuity and good judgment in adopting, adapting or developing new designs. Manufacturers of materials and equipment have perfected new techniques and developed new products that eased the designers' tasks immensely. And contractors have put the new buildings together as fast and as well as ever they did those of more familiar pattern.

THE SIGNIFICANT FACT, however, is not that a large number of individuals have earned accolades, but that they have kept the war building program on schedule. Because this program must go on, with materials problems becoming ever more acute, it is important to know how designers and construction men have solved the problems attendant to the materials scarcity that already prevails. How were the war buildings of 1942 built? What assets have we accumulated that will aid the design and construction of the war buildings of 1943? It is to these questions that this special section is directed and to which this brief introduction gives some background.

THAT WAR BUILDINGS of 1942 would be different from those of 1941 was evident when the WPB's critical materials lists began to include building materials. Aluminum was first, followed by copper, zinc and alloy steels, and then came restrictions on structural steel and reinforcing bars, on cast iron and quick-drying paints. Building frames were switched to concrete or timber; installed equipment came out with fewer alloy steel parts; metal ducts were painted in place of being galvanized, or were made of fiber board or cement-asbestos; flashings of noncritical materials took the place of copper; sash was built of wood instead of steel. In brief, wherever it appeared that it was more important for a material to be used for combat equipment or supplies than for building construction, its use in the latter was stopped or drastically reduced. Then, because the need did not vanish with the material, designers were immediately faced with the problem of selecting a suitable alternate to fill the need from among materials that were still available.

SUBSTITUTION OF one material for another was not, however, a simple process, because questions of design safety, of relative economy, of durability, and of speed of construction also were involved. Thus steel could be saved by using an alternate material, by using higher unit stresses or by adopting a structural system that would be more economical of steel than a conventional design. Which one of these expedients to use was a question to be answered not by guesswork, but by careful study. Or when it came to saving steel in reinforced concrete, steel stresses could be raised, concrete stresses could be lowered, or a combination of the two could be tried; there were advantages and disadvantages to any choice that was made, and all of these had to be weighed. And should the use of a timber structure be considered, there was the matter of determining whether the members should be shear-plate-connected trusses, plywood girders or laminated beams or arches. It is probably correct to say that, despite their emergency nature, the war buildings of 1942 required greater ingenuity and more thoughtful study than was commonly the case with their peacetime predecessors.

NOR WAS IT ALWAYS within the designer's power to use the solution that his studies indicated would be best. There was, for example, the problem of codes and specifications that contained prohibitions against certain practices or dictated the use of certain materials. Specification troubles were resolved, however, probably because when a material is no longer available it can't be specified. But much credit is due the WPB Specifications Branch for getting federal emergency and ASTM emergency specifications adopted quickly. This Branch also has come through with emergency specifications for buildings of both steel and reinforced concrete that not only permit but require changes in design practices, which will conserve steel. War buildings of 1942 are better and safer and more successful in the conservation of critical materials because of this effective leadership exercised by WPB.

VIEWING THE RESULTS of the first year that building construction has been carried on in an economy of scarcity, there is much reason for satisfaction. It is important not to lose perspective, however, and assume that the war buildings of 1942 are completely successful. Not enough critical materials were saved, and many of the designs lacked the efficiency that further study and experience can assure. These shortcomings offer a challenge for 1943, when materials shortages may be expected to become more acute. What has been learned of improvising and of careful emergency design in 1942 can then be used to good advantage.

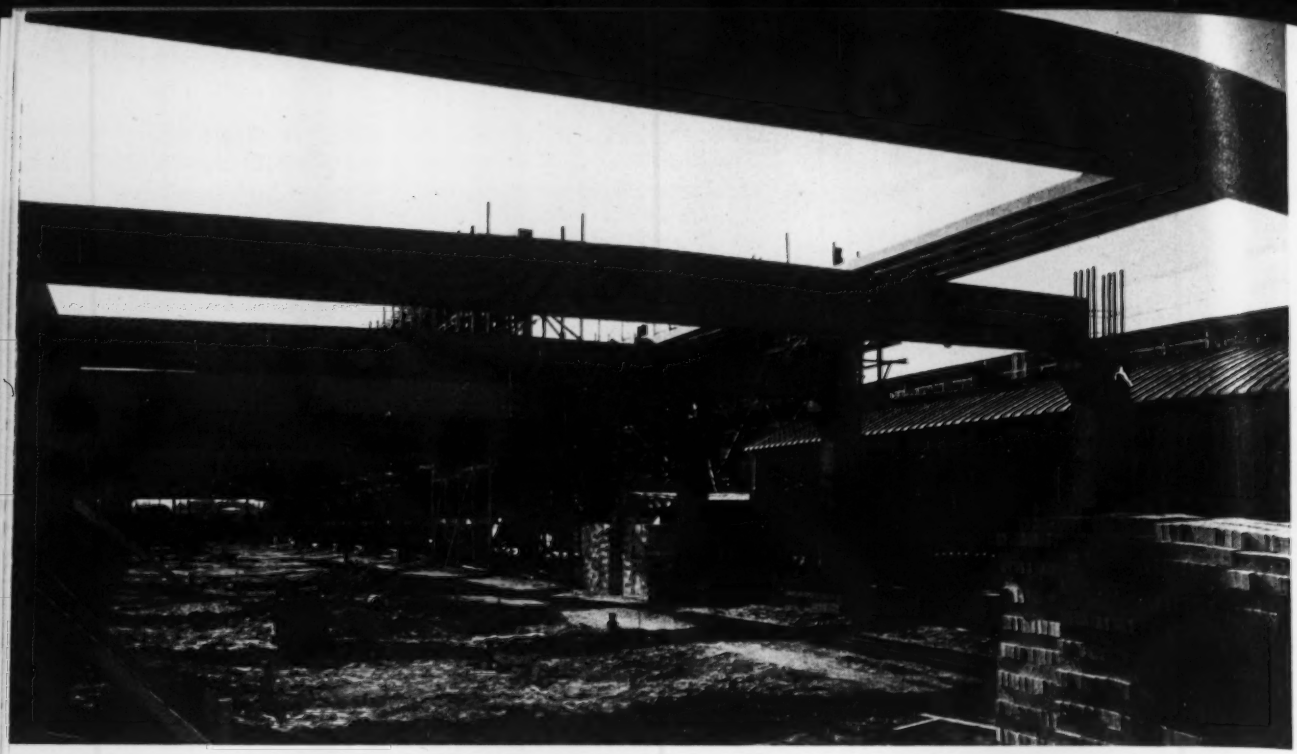


Fig. 1. Concrete columns support laminated wood girders and purlins in a new war plant.

Concrete and Laminated Wood Framing

***Contents in Brief**—Because steel detailing and fabrication would have taken four months, (a month beyond the time that the owners wanted the complete structure turned out), and because of the necessity to conserve steel, the designers of a large shop building turned to a combination of concrete columns and laminated wood girders, purlins and knee braces. The result was a speeding up in design and construction that permitted meeting the time schedule. Spans of 62 ft. required wood girders 35 in. deep.*

SPEED of design and construction, utilizing a combination of reinforced-concrete supports and laminated wood girders, featured the erection of the new machine shop, built by the Defense Plant Corp., for a Wisconsin machine tool company. First consideration was given by the architects and the engineer-contractor to the use of structural steel framing throughout, for in 1941 they had designed and built a steel-framed machine shop as an emergency plant facility for the same company, located directly north of the site for the new structure.

An estimate of the earliest delivery on structural steel was figured at 16 weeks, allowing five weeks for the mill and two weeks for the fabricator, after requisite shop drawings were prepared—which on the previously constructed building required nine weeks time. The owners were anxious for a completed building about four weeks before the structural steel could be detailed, fabricated and delivered.

The desire to meet the scheduled early completion date, and to conserve critical materials, led the architects and engineer-contractor to a decision upon reinforced concrete and laminated wood for the framework of the building. Concrete was chosen for all columns, crane rails and eave struts, and laminated wood units for the roof girders and purlins.

This shop building, irregularly shaped, 206 x 417 ft. over all, is divided into four bays: A 45-ft. monitor bay with a clear height of 12 ft., a 40-ft. low crane bay for a 10-ton crane, with a clear height of 32 ft. 8 in.; a high crane bay for a 20-ton crane, with a clear height of 42½ ft. and a span of 62 ft.; and a 59-ft. transfer section providing craneways connecting with the shop to the north. All columns are spaced 20 ft. longitudinally.

Special column design

Typical bay design embraced reinforced-concrete columns for the vertical members and continuous concrete beams for the longitudinal crane rails and eave struts. Columns were flared to provide a shelf for the crane rails and roof girders. Where necessary, 6x24-in. openings were left in the columns to provide a protected space for a number of utilities including steam, air, water lines and electrical conduits.

Malleable iron inserts taking either a ½-in. bolt head or a ½-in. nut were embedded in each column to fasten the utility conduits that run down the columns from the main leads above. Also, in order to provide anchorage for job cranes that the owner might

install at a later date, metal brackets with anchor bolts were concreted in place in each of the columns in the low and high crane bays.

Exterior walls are face brick up to a stone sill, then wood sash to the concrete eave strut. Exterior concrete columns are recessed so that brickwork and sash are continuous around the building.

Laminated wood girders

The entire roof construction is timber, made up of laminated wood girders, purlins and column knee braces and plank covering. All laminated units were designed and furnished by Unit Structures, Inc., Peshtigo, Wisc.

In the high bay the girders span 61½ ft. They are 15 in. wide, 35 in. deep at the center, tapering down to 26 in. deep at the ends. In order to make a girder 15 in. wide, two laminated girders, each 7½ in. wide, were glued together. The laminations run horizontally and the boards were carefully planed to 1⅜-in. thickness for uniformity and to obtain a proper surface for application of glue.

Girders in the low or monitor bay are 9½ in. wide, made up of planks of that width. They are 32 in. deep at the center, 28 in. at the ends, and span 42½ ft. In the center or low crane bay the laminated girders are also 9½ in. wide but are 29 in. deep for the full span of 38 ft.

Purlins are 12 in. deep, built up of 2-in. planks, surfaced to 1½-in. thickness. Most purlins are 6 in. wide, except for 8 x 12-in. sections under the monitor walls. The purlins are spaced either 8 or 9 ft. apart, and carry the roof of 2-in. tongue-and-groove planking, 1-in. insulation and a tar-and-gravel built-up weather surface.

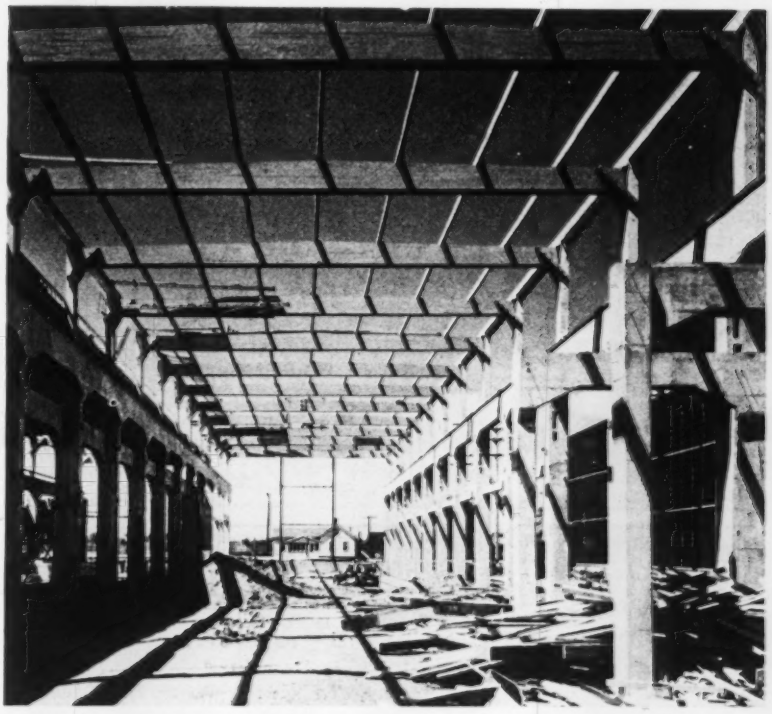


Fig. 2. Wood roof framing of high crane bay, ready for roof planking. Note heavy concrete crane girders.

At each column is a pair of knee braces, connecting with the girder to provide some lateral stiffness. The braces, 6 x 6 in., are also laminated. built up of 2-in. stock. To compensate for the difference in width of columns and girders, the braces are notched around the columns. Connection to the girders is by bolts and 4-in. split-ring connectors. At the column connections 4-in. shear plates were set in both the concrete and wood, making the point of contact a pair of shear plates.

Fast design and construction

Preliminary drawings were started March 26 from shop sketches of machine layouts submitted by the owner and were approved March 28. On April 1, approval was received from the Defense Plant Corp. to proceed

Fig. 3. Completed building is characterized by large areas of continuous sash. Monitor bay is in foreground, low crane bay next, and high crane bay beyond. Transfer bay is on far side of high crane bay.

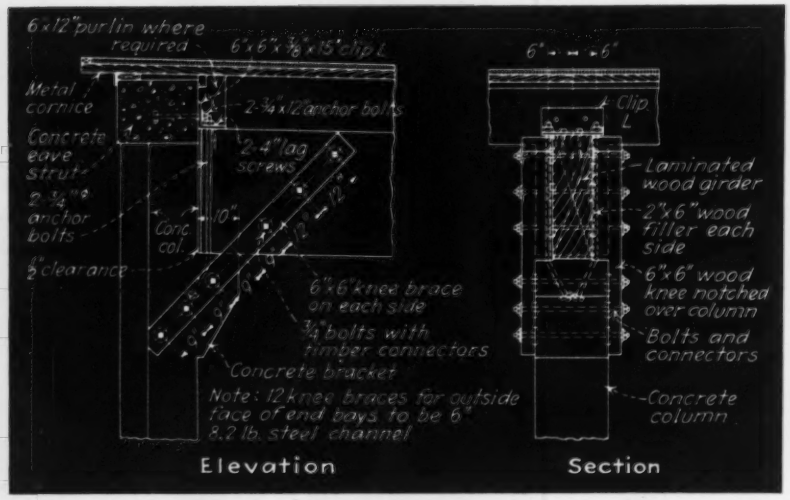


Fig. 4. Details of concrete bracket and wood knee brace connections between laminated timber girders and concrete columns.

Fig. 5. How the combination of concrete and laminated wood construction looked in the completed building as it approached the equipment-installation stage.

with the work. Final drawings were started immediately. Five days later construction operations were begun on foundation walls and footings.

The first laminated wood girders arrived April 28, and were erected the following day in the monitor section. The framing in both crane bays was completed by May 21, and on June 15, less than 12 weeks from the time preliminary plans were started, the building was ready for the owner to install shop machinery.

The adjacent shop, built in 1941 of structural steel, was completed in 17 weeks from the time plans were ordered. The use of the combination of reinforced concrete and wood in this 1942 unit, comparable in size and layout, resulted in a net saving of time of construction of five weeks, thereby permitting the manufacturing operations so necessary to the war effort to begin that much sooner.

High-early-strength cement concrete was used for the columns, beams and crane rails, and normal portland cement concrete for the footings, foundation walls, and for floors on the ground. All concrete was ready-mixed.

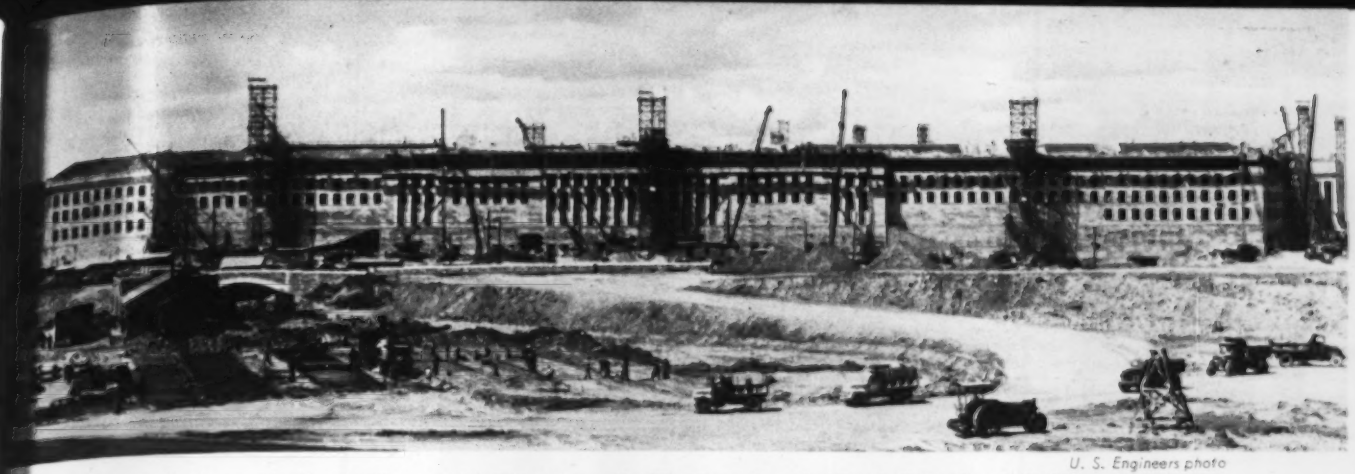
Careful concrete forming required

The concrete columns in the high crane bay, rising 42½ ft. from floor level to the bottom of the wood girders, had to be built as free-standing, with a ½-in. clearance allowance at each end of the girders. This clearance, while small, was not beyond the capabilities of the forming and shoring crew of the contractor. The concrete columns were constructed so true and accurately that no difficulties were encountered by the erection crews in setting the prefabricated laminated wood girders.

After a final check the concrete structure, as built, showed a use of 175 tons of steel, including reinforcing, connectors, inserts, anchor bolts and plates, and a small amount of steel sash. On the basis of a steel design similar to the adjacent building, but using the new layout, it is estimated that 600 tons of steel would have been required. Thus, by using the concrete and wood combination in the new building about 425 tons of steel were saved.

An interesting feature, indicating the flexibility of this combination of reinforced concrete and wood framing, was the ability of the engineer-contractor to change dimensions of the crane bay spans to fit the 10 and 20-ton cranes as finally obtained for the shop. Cranes to fit the spans as originally designed could not be obtained. Such a change after construction was started would have been difficult in a steel design.

The cost of construction was approximately $7.00 per sq. ft., including railroad spurs, fencing, structure, lighting, electrical and mechanical work. F. J. Stepnoski & Son was the architect and Hutter Construction Co., the engineer-contractor.



U. S. Engineers photo

Fig. 1. Pentagonal in shape with each side 921 ft. long, the War Department's office building has 4,000,000 sq. ft. of space.

Planning the World's Largest Building

Contents in Brief—*To concentrate most of its workers in the Washington, D. C., area in one structure, the War Department is now completing an office building that has 4,000,000 sq. ft. of floor space. Five-sided or pentagonal in shape the reinforced-concrete structure is five stories high and in some areas has both a basement and sub basement. The offices are laid out as concentric rings about a six-acre central court. Thickness of the building from the outside to the court is 386 ft. and this distance is broken up by light courts. Each of the five exterior sides is 921.6 ft. long while the sides around the inner court are 360.8 ft. long. Pedestrian circulation within the building is by means of ramps leading from floor to floor and by radial corridors on each floor that branch out much as spokes of a wheel from the main corridors encircling the inner court.*

ONE of the most noted structures to be built as a part of the war program is the office building being completed at Arlington, Va., to accommodate most of the War Department office workers in the Washington, D. C. area. That this huge structure, which is known as the Pentagon Building because of its shape, was planned and constructed in slightly more than a year is a great tribute to the architects, engineers and construction men who made this accomplishment possible.

Believed to be the largest building in the world, the structure is located on a site of more than 400 acres across the Potomac River from Washington, D. C., partly on the old Washington airport and about a mile south of the Lincoln Memorial. Preliminary concepts of the building were formulated late in July of last year, the site was decided upon Sept. 3, the general contract was approved Sept. 8, and construction was begun Sept. 11. Progress was so rapid that the first permanent offices were available on April 28, of this year, and completion of the entire structure is set for Nov. 15.

Knowing that such a rapid program was to be necessary, one of the first acts of the War Department engineers in charge was to bring together a planning and design group of some 350 architects and engineers, many of whom were in private practice and well known for their abilities and accomplishments. That this was a wise choice was proved by the results obtained.

Site selection a big problem

An early task of this group was to aid in determining the best site for the new building. Two locations on the Washington side of the Potomac River in the District of Columbia were studied, one near Walter Reed Hospital and one near the Navy Hospital. Both of these sites were abandoned because of the difficulty and the great expense that could be expected in obtaining a sufficiently large area and because of the magnitude of the transportation problems, including greatly increased traffic loads on the streets in those areas and demands for extensive parking facilities. Next, five different sites on the Virginia side of the Potomac were considered, and the present location was chosen after President Roosevelt had conferred with Lt. Gen. Brehon B. Somervell, then head of the construction division of the Office of the Quartermaster General.

An Arlington site was decided upon for four reasons. First, because the federal government owned a large amount of land in that area, a site of more than 400 acres could be obtained, which was sufficient for a large building and accompanying facilities. Second, a good solution of the transportation problem was possible, since improvement of the existing highways and construction of other roads would provide a highway system, allowing separation of the heavy bus and truck traffic from passenger cars. Third, the site was sufficiently large for adequate and convenient parking for 8,000 cars, which was considered as important as providing suitable highway connections. Fourth, there is an increasing tendency for governmental employees to live in Virginia. There they are close to Washington and out of the congested area.

Therefore, by locating the building in Arlington, traffic difficulties in Washington would be reduced, as fewer people living in Virginia would

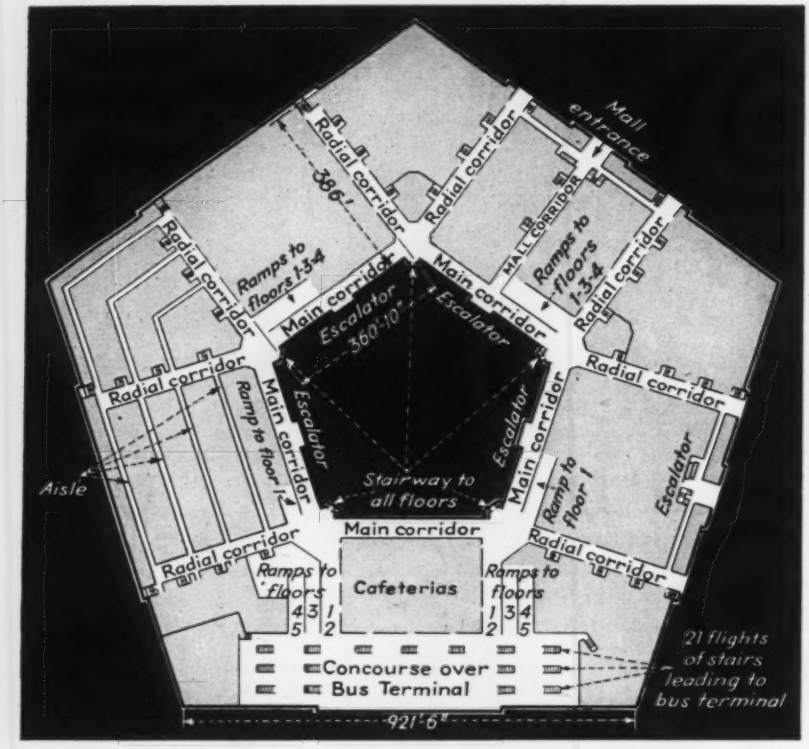


Fig. 2. Plan of second floor showing the corridors and aisles by which pedestrians will circulate through the building; the aisles shown at the left are common to all parts of the building but were left out in the other areas to simplify the drawing. The layout on the other floors is very similar.

Harris & Ewing photo

Fig. 3. A typical office area, which has a 10-ft. wide inner bay and two 20-ft. outer bays; the inner bay is kept free of office furniture to serve as an aisle. Note the exposed beams in the side bays and in the center the hung ceiling, which hides the air-conditioning ducts.

need to go into the District of Columbia during working hours. In addition, those War Department workers living in the District of Columbia and employed in the new building would travel against the maximum flow of traffic and consequently over the more open lanes when going to and returning from the new building.

Because of the great number of workers to be accommodated, an early assumption in planning the building was that its height should be so limited that travel from floor to floor would be by means of ramps or stairways and not by multiple and costly vertical mechanical transportation; furthermore a complete system of escalators and elevators would require extensive space. Thus, an early decision was to limit the height to four stories plus a basement. A low building also was considered desirable in order to avoid interference with the views of and from the Arlington Memorial and the Lee Mansion.

Knowing the number of stories, the approximate number of people to be accommodated, and the desired floor space per person, the planning group next prepared estimates as to the ground plot necessary.

Pentagonal plan chosen

Several different plan outlines were studied, but the most satisfactory was obviously one that would offer the shortest lengths of travel for pedestrian traffic within the structure; the ideal was seen to be a series of concentric circles with travel lines along the radii. Finally, out of the shape of the site grew a five-sided or pentagonal plan, which was considered to offer, in principle, the advantages of a circular shape and yet give a pleasing and strong appearance.

The plan of the building was to be developed around a large pentagonal court to provide accessibility for maintenance equipment and fire-fighting apparatus to the inner portions of the building. The 6-acre inner court also was seen as a place of relaxation during lunch hour for occupants of the building.

To limit the thickness of the building from the outside to the court seemed desirable from the standpoint of distribution of supplies, fire-fighting and maintenance purposes. Thus, this dimension was made 386 ft., while the five exterior walls measure 921.6 ft. in length, and the inner walls 360.8 ft.

Equally important with the choice of the most satisfactory shape was the layout of corridors and office spaces. For workers wishing to go from one side of the building to another, the shortest route would, of course, be directly across the inner court. Since this scheme was not feasible, the best arrangement was to provide on all floors a main corridor extending all the way around the inner court from which ten radial corridors, branching much as the

spokes of a wheel, give access to aisles traversing the wings.

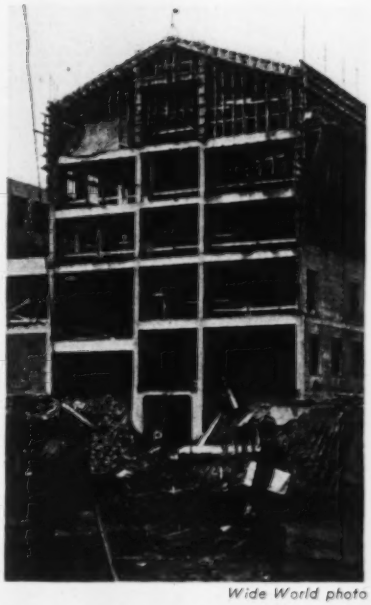
In the plan developed the wings are parallel to the exterior walls and become concentric pentagonal rings. Each ring is 50 ft. wide with a 30-ft. light court between rings; exception to this arrangement is the 40-ft. wide inner road forming the third light court from the outside on four sides of the building. Access to each end of this roadway is provided by passageways running from the outside of the building into the inner court.

The plan of concentric rings has three advantages. First, it permits most of the offices to be sufficiently daylighted as to require little or no artificial lighting throughout most of the day. Second, this scheme allows most of the office spaces to extend from one radial corridor to the next and thus to vary in size and shape; the largest office area is about 50 by 400 ft. A third advantage is that such a plan also allows most facilities such as stairways, toilets, drinking fountains, public telephones and general use spaces to be concentrated along the radial corridors.

As plans developed, pitched roofs were used on the radial and main corridors as well as over the outer ring of offices. This arrangement was to provide the necessary space for air-conditioning equipment, ducts and other utilities. The sloping roof on the outer ring also improves the appearance of the building.

Five-story structure decided upon

The site finally chosen was on two general levels (30 ft. higher on the upper than on the lower side) and not on a level site as originally expected. Therefore, the basement story of the original plan became the ground floor on the upper level of the final site; and on the lower level a basement and a sub-basement were provided.



Wide World photo

Fig. 4. Inner concentric ring of the building under construction. Transverse column spacing is 20 ft. in the outer bays and 10 ft. in the center.

As a result of these conditions, the structure became a five-story building with a basement and sub-basement under a part, and the total enclosed floor space was increased to about 4,000,000 sq.ft.

While the studies were being made to determine the most satisfactory general shape and size of the building, consideration was given to the space arrangement of the structure. An early decision was that all bus traffic should arrive and leave from one side of the building. For convenience, to protect the passengers from bad weather, and to reduce the time from bus to office, it seemed desirable that the passengers be delivered to a terminal inside the building at ground-floor level. To permit the vehicle to pass through the structure at that elevation, three 20-ft. wide passageways are provided the full length of one side. Of the roadways, which are paralleled by 10-ft. wide platforms, two will be used by buses and the other by taxis.

Passengers arriving by either bus or taxi will travel up one of 21 stairways to a 120x680 ft. concourse on the floor above, adjacent to which a bank, small stores, a barber shop and a large soda bar are located. From the concourse the workers will continue to their offices by way of six ramps leading directly to the main interior corridors previously mentioned. The ramps are a minimum of 20 ft. wide, and the slopes are limited to 10 percent. They are arranged in groups of three at the two ends of the concourse; from each group one will lead to the corridors on the second floor, one to the third floor, and the other to the fourth floor. Still other ramps will connect the main interior corridors. The ramps are used to handle mass movements of workers safely, rapidly and conveniently, and to distribute them direct to their various office floors or to transportation leaving the building.

Buses to handle 25,000 people

Passengers going home from work and traveling by bus and taxi will reverse the procedure. Necessary fares will be paid at turnstiles in the concourse at the head of each flight of stairs. With the buses for a given destination always using the same loading points, bus arrivals and departures are expected to be very rapid.

Since the roadways are two lanes or 20 ft. in width, one lane may be used for loading and the other for passing. This arrangement will permit the loaded buses to leave immediately. With office hours staggered, the bus facilities are expected to carry about

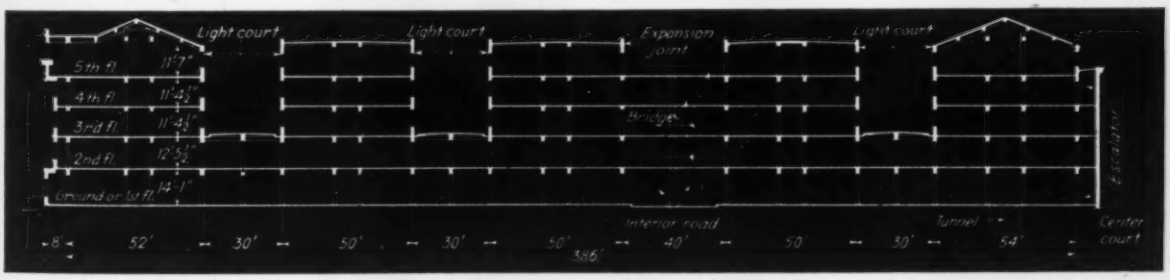


Fig. 5. A cross-section through one side of the building, showing the spacing of the light courts and the location of the inner road, which is to be available on only four sides of the structure. Although no basement was needed for that portion of the building shown, in some areas a basement and sub-basement was required.

25,000 people in one hour.

Nearly as important as the problem of handling those workers coming to work by bus, was the question of how best to take care of passenger car travelers. For such workers two large parking lots, each for 4,000 cars, are under construction on opposite sides of the building. From the parking areas, the passengers will enter the building on the ground floor and travel along 34-ft. wide radial corridors to the main corridor circling the court and then via ramps to the various floors and their offices.

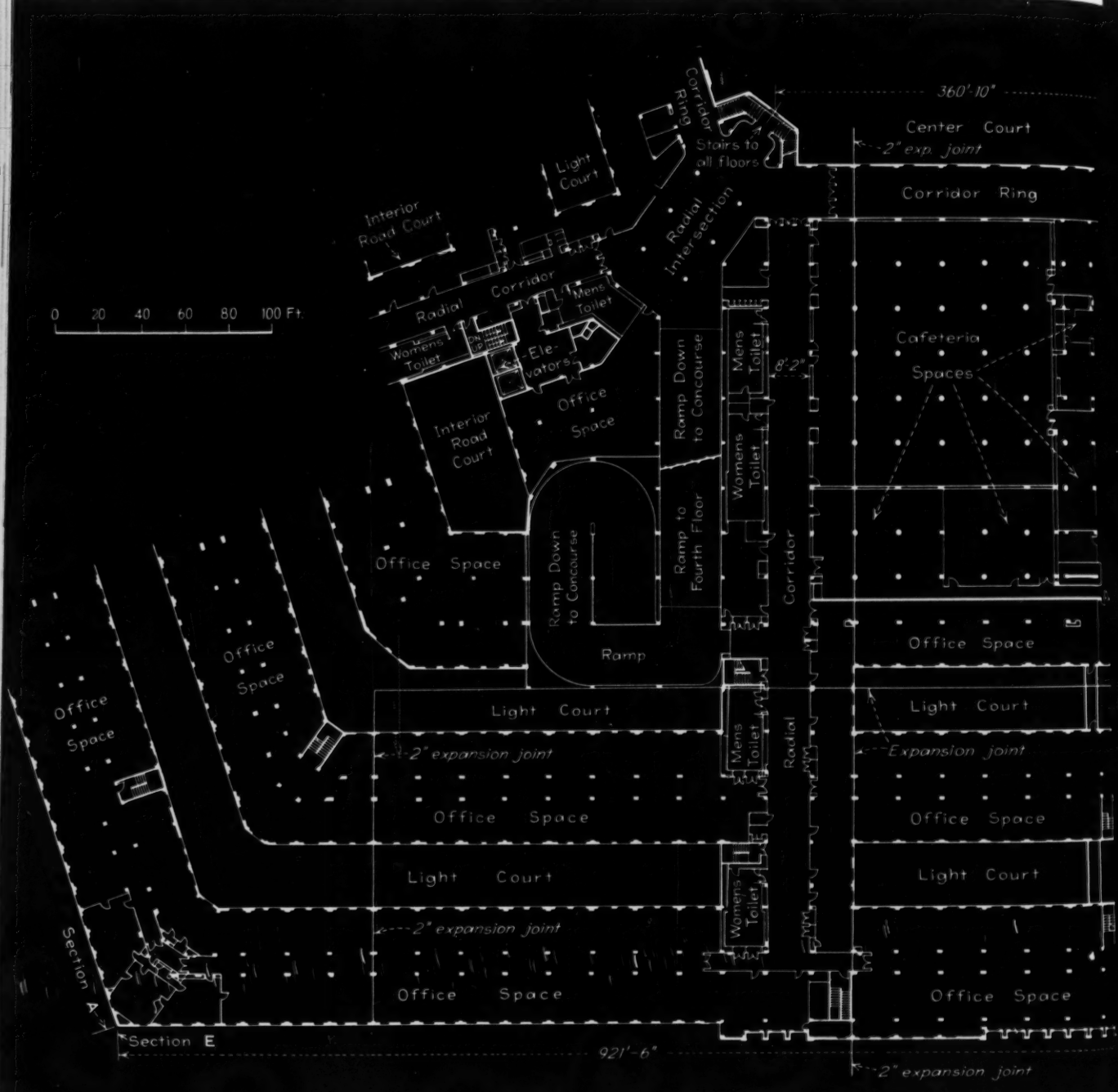
Limited escalator service is provided, primarily for ill or partially disabled employees. These are generally located along the exterior walls surrounding the inner court. Stairways, mostly along the radial corridors, are available for quick access from floor to floor where use of the ramps would entail a somewhat longer route. Additional stairways were added for escape in case of fire.

Cafeterias above concourse

As eating facilities had to be installed within the building, large cafeterias were located on the second, third and fourth floors above the concourse. That part of the building containing the bus terminal varied greatly from the typical layout and this was more adaptable for special use areas, such as cafeterias. Also concentration of these special facilities allowed the remainder of the building to be standardized.

Another important problem in allocation of space was to arrange for 600,000 sq.ft. of easily accessible storage area. The basement and subbasement were planned for this use, since their lack of natural lighting was not a disadvantage. In addition they would be readily accessible from special roadways. Storage of operating and maintenance supplies has been placed on the ground floor adja-

Fig. 6. Third floor plan of Section E; the layout on the other four sides of the building is very similar. The con-



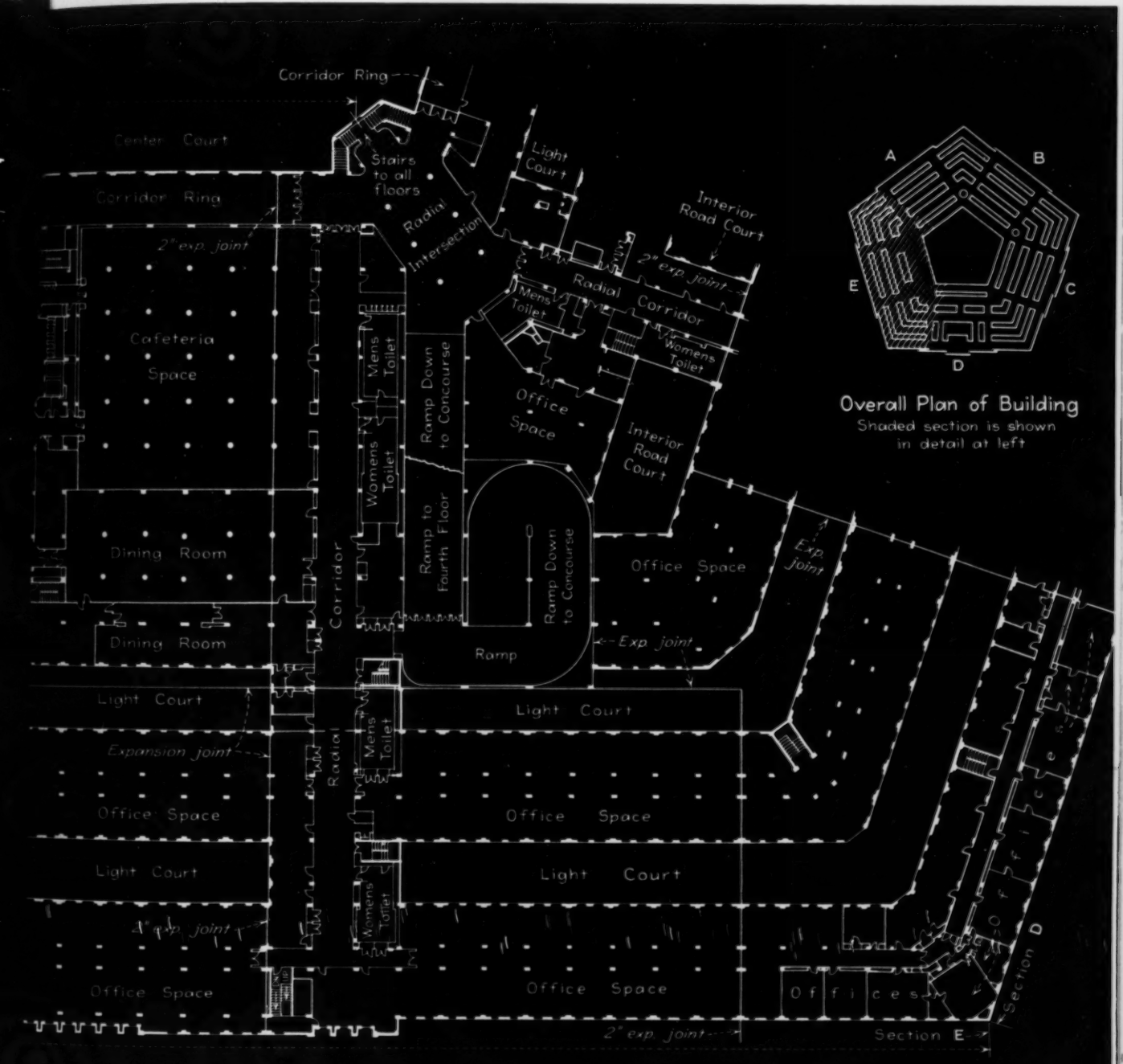
cent to a 20-ft. wide unloading platform 300 ft. long and in close proximity to the bus terminal exit. Smaller storerooms for some supplies occur on each floor in corners less suitable for other uses. Distribution of supplies within the building is by freight or service elevators located near the points at which the radial corridors join the main corridors.

In preparing plans for the Pentagon Building important requirements had to be met. The plans had to be turned out in a hurry, and construction had to be standardized everywhere possible for maximum speed and economy. One of the first steps to meet these requirements was to develop a careful checking system in order to coordinate the preparation of the architectural, structural and mechanical plans and specifications. Also, a standard structural design procedure was outlined so that all design followed the same general method. As a result of these measures, coupled with employment of well-qualified contractors, the world's largest building will be completed on schedule in less than 15 months after the first construction drawing was prepared.

Soil conditions at the site were highly variable, including strata of loam, sand, silt, gravel and water-bearing material. No rock was encountered. Such soil conditions made necessary the use of pile footings. Wood piles were considered, but their use was inadvisable because of the variable water level and expected delay in procuring a sufficient quantity. Thus, cast-in-place concrete piles were used throughout.

The number of piles in a footing varied from a minimum of two to a maximum of thirty-two. In all, 41,492 piles having an aggregate length of 1,000,751 ft. or over 200 miles were required. The average pile length was slightly under 27 ft.; the maximum length was 45 ft.

centric office rings are 50 ft. wide and the light courts 30 ft., except that formed by the 40-ft. wide interior road.



All types of construction were given serious consideration. The employment of a reinforced-concrete frame was decided to be most desirable for this huge building; incidentally this design saved thousands of tons of steel. The framework, in which story heights vary from 11 ft. 4½ in. to 21 ft. 1½ in., was designed as a continuous structure, and in general the framing was of the slab-and-beam type. In certain areas, however, slab-and-joist and flat-slab framing were used because of space requirements. Expansion joints 2 in. wide were provided at an average spacing of 200 ft.

For the most part a 2,500-lb. concrete was used but in some areas where space was very limited a 3,750-lb. concrete was specified. Design stresses in pounds per square inch for the 2,500-lb. concrete were: in compression, 1,125; in shear where web reinforcing was used, 150; and for plain concrete in shear. 75. Allowable stresses with the 3,750-lb. concrete were increased in proportion. Intermediate grade reinforcement was specified and working stresses of 20,000 psi. in tension and 16,000 psi. in compression were used.

A typical 50-ft. wide ring consists of three bays, a 10-ft. center bay and two 20-ft. outer bays. The longitudinal column spacing is 20 ft. Throughout most of the building the floors are designed for a 150-lb. per sq.ft. live load to permit any or all floors to be used for storage. Typical floors are 5½ in. thick, with beams 14x20 in. on a 10-ft. spacing, while the girders are 14x26 in. The electrical conduits are embedded in the slab.

In the kitchen and cafeteria areas slab-and-joist construction is used, the slab being 2¾ in. thick and the joists 10 in. deep below the slab. In these areas the electrical and other conduits are carried in the space between the joists and the hung ceiling.

In the typical rings a hung ceiling is used in the middle bay to conceal the air conditioning and other ducts, but in the other bays the beams are left exposed and the underside of the slab faced with acoustical plaster or other sound-deadening material.

For the floors in the office areas a monolithic cement finish is used, and over this is applied a ⅛-in. thick asphaltic tile covering, which was economical and easily obtainable. For the ramps, main corridors, concourse and other areas where traffic will be heavy, terazzo surfacing is used. Radial corridor floors are generally covered with $\frac{3}{16}$-in. asphaltic tile.

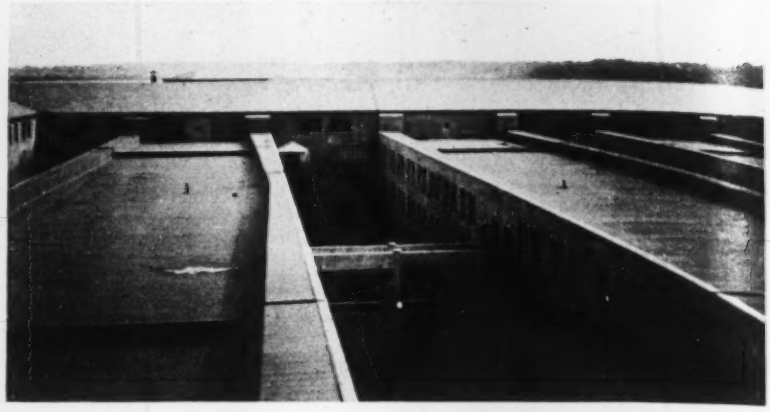


Fig. 7. To provide a short cut for pedestrians between the concentric office rings reinforced-concrete footbridges span the light courts. In the background is the sloping roof of a radial corridor.

Limestone outer walls

In designing the exterior walls on the outer periphery of the building a 6-in. thick limestone facing with an 8-in. thick brick back-up in two courses was considered desirable and in harmony with many other public buildings in the Washington area. Other exterior walls, such as around the six-acre inner court and the light courts, were designed of 10-in. thick reinforced-concrete construction rusticated on the exterior face. The exposed concrete wall was chosen because of the architectural treatment and construction speed possible. The concrete was rusticated by beveling the edges of the horizontal wood sheathing used for the forms.

The typical layout for the windows is 6x7-ft. units on 10-ft. centers. This spacing and size allowed ample room for ducts to be carried up each side of the columns.

Permanent interior partitions are brick around the ramps, stairways and transformer rooms and hollow tile around the cafeterias, restaurants, washrooms, and similar areas. In the office spaces the general aim is to keep the space clear. However, where subdivisions are desired ½-in. wallboard on 2x4-in. wood studs spaced at 2-ft. centers is used.

As previously mentioned, a sloping roof was used over the radial corridors and the outer and inner concentric rings. This was both for appearance and to provide necessary space for the air-conditioning machinery. These roofs are designed for a snow load of 30 lb. per sq.ft.

The sloping roof consists of a 4½-in. thick reinforced-concrete slab carried on beams, which in turn are supported by rigid-frame bents. The roof slab is covered by a built-up composition roofing on which 2x2-in. wooden nailing strips are laid. These carry a 1x6-in. wood sheathing and a slate roof. This roof design was chosen for two reasons. Number one was that since the contractor was to be set up for mass concreting, rapid construction would result. Secondly, a fireproof construction resulted, which was very desirable over the areas where so much mechanical equipment was to be housed.

Over the intermediate concentric rings, a flat roof of the slab-and-joist type is employed. The slab is 2¾-in. thick, and it is covered by a five-ply, built-up, composition roofing.

Service facilities

In providing the necessary service facilities for the Pentagon Building several important factors affected the work: (1) Services for a building of a size never built before had to be planned; (2) design and installation had to be done in a hurry; and (3) costs were not to be excessive. How these conditions are being met is illustrated by the fact that all facilities were available for the first occupants when they moved into the building nine months after construction started.

To bring water to the building, construction of two miles of 30-in. spiral-welded steel main with a capacity of 4,500 gpm. was necessary. At the building the pipe reduces to 18

and 16-in. lines and makes a complete loop around the structure. From this loop, which also feeds 43 fire hydrants near the building, four 10-in. mains lead into the building.

Inside the building the 10-in. lines join a main of equal size that extends around the structure inside a tunnel under the main corridor. From this loop lines branch off via tunnels under the radial corridors, and from here connections are carried upward in pipe spaces to such facilities as drinking fountains, toilets, fire-hose cabinets and mechanical rooms, which are located mostly along walls of the corridors.

In all water had to be provided for 2,300 water closets, 525 urinals, 1,700 lavatories, 155 slop sinks, 550 drinking fountains and 50 shower baths. In addition, connections had to be made to 600 fire-hose cabinets, which are spaced about all floors so that the maximum hose reach to any point within the building is 125 ft. Vertical risers to the hose cabinets are generally located near the stair wells.

Sewage treatment plant built

Waste water is carried down discharge outlets housed in the pipe spaces previously mentioned. The collecting pipes in the tunnels under the radial and main corridors combine for discharge through a 24-in. dia. reinforced-concrete sewer that leads to the 3.2-mgd. sewage treatment plant that was built especially to provide complete treatment for the wastes from the Pentagon Building and an adjacent military reservation. For details of this plant, the effluent of which goes into the Potomac River, see *Engineering News-Record*, June 4, 1942, p. 925.

Utility supplies electricity

Electricity is received inside the Pentagon Building at sixteen 2,000-kva. substations. At these points it is stepped down to 120-208-v., three-phase, four-wire current, which is used throughout the structure for light and power. The radial corridors are used extensively in dispensing electric current throughout the building.

On typical floors the branch conduits for general overhead lighting, which is mostly indirect incandescent but in special cases fluorescent, are carried in the floor slab above. Switch legs and receptacles are tied into overhead conduits as required. About 50,000 ceiling lights are used.

The Pentagon Building will be air-conditioned for a fluctuation from a 95-deg. F. temperature in summer to zero conditions in winter. During the summer, chilled water will be circulated through dehumidifiers of the closed-coil and spray type located on the top floor. The air is delivered by induction units below each window and by ceiling diffusers.

The temperature of the air will be influenced by the amount of sun on the windows and by the outdoor temperature, but final control will be by a forced-circulation, hot-water coil within the window unit and controlled by a self-contained, hot-water valve. Control of the temperature of the discharge air in winter will be in much the same way.

Asbestos ducts save steel

Supply ducts for the window units are carried upward along the columns in the exterior walls. These ducts are made of prefabricated asbestos tubes; the return ducts in the ceiling are of black iron, except that in those areas where condensation is expected galvanized iron is used.

The bus terminal will require a separate ventilation system, and eight 40,000-cfm. fans will be used to remove air from that area. These fans will be equipped to go into operation automatically if the carbon monoxide content in the air exceeds a safe maximum. Fresh air delivered to the terminal in the winter will be tempered to prevent condensation and to minimize the formation of ice.

Three systems of inter-office communications are provided—a network of 16,000 telephones, messenger service, and, in limited areas, pneumatic tube facilities.

Because of the large number of fire-hose cabinets and because of the fire-proof construction employed a sprinkler system was not considered necessary for all parts of the building. However, in the large storage spaces and other locations where a fire hazard is considered to exist, both an efficient sprinkler network and the hose cabinets are available.

Those in charge

The Pentagon Building was conceived by the construction division of the Office of the Quartermaster General, when this division was headed by Lt. Gen. Brehon B. Somervell. After the field work was underway that division was transferred to the Corps of Engineers, which is completing the construction. From the start, Lieut. Col. Clarence Renshaw has been officer in charge and G. Edwin Bergstrom and David J. Witmer chief architects.

General contractors for the work are the combined firms of John McShain, Inc., Doyle and Russell, and Wise Contracting Co., Inc. For this organization J. Paul Hauck is project manager. Details of the construction operations are given in *Engineering News-Record*, June 4, 1942, p. 920.

Fig. 8. Supply ducts leading to air-conditioning units below the windows are precast asbestos tubing. Use of this type of duct instead of metal resulted in a big steel saving.

Blimp Hangars Set New Timber Arch Record

Contents in Brief—The longest timber arches in this country will constitute the main framing of the Navy's new blimp hangars. Of 246-ft. span, they have chords of two 4x14's. Assembly is by bolts and metal shear connectors. Arches rest on concrete bents 25 ft. high.

THE necessity for conserving steel has been turned into a virtue by the design staff of the Bureau of Yards and Docks in meeting the demand for a large number of hangars to house and service the Navy's growing fleet of patrol blimps. By designing the hangars in timber, the Bureau has not only made the greatest steel saving possible, but in addition it has developed a timber, spandrel-braced arch whose span of 246 ft. (235 ft. clear) sets a new record for this type of construction.

Even this unusual span might have been exceeded but for lack of precedent. The longest previous timber arches are those of 200-ft. span used in the 1939 San Francisco exposition buildings on Treasure Island, and it was decided that about a 25 percent increase over this figure was all that could be justified safely at the present stage of the art. An original steel hangar design used arches of 325-ft. span and, although this could not be duplicated in timber, the effective width of the timber hangars was increased somewhat over the actual span of the timber arches by setting the latter on 25-ft. high concrete A-frames. The details of these A-frames, are an interesting element of the hangar design.

The timber hangars are catenary arch-shaped structures 1,058.5 x 297 ft. in overall plan dimensions, and 171 ft. high from floor to roof. Each hangar contains a total of 3,000,000 b. ft. of timber, of which 750,000 b. ft. are in the arches. Down each side of a hangar, occupying the "lean-to" space between and under the concrete A-frames, are lines of shops and offices, but the remainder of the floor area is clear. Arches are spaced on 20-ft. centers, braced apart by struts and X-bracing in the plane of the bottom chord, and by the purlins and a system of K-bracing in the plane of the top chord. The 3 x 14-in. purlins support 3 x 12-in. rafters running parallel to the arch ribs, and the roof is sheathed with 2-in. planking.

The only structural steel in the hangars is in the vertical end doors, which are of the rolling segmental type and among the largest ever built. Each segment is an all-welded vertical box truss 33 ft. wide, 120 ft. high and 3 ft. thick. Due to connection difficulties for developing sufficient longitudinal strength in the roof framing to resist end wind pressures, it was necessary to divorce the door framing from that of the hangar.

The timber arches, as shown in Fig. 2, have a span, center to center of their concrete bent supports, of 246 ft. and a rise from base to centerline of 140 ft. They are 19 ft. deep at the base, reducing to 13.64 ft. at the crown, and are assembled by 4-in. split-ring or shear connectors and ¾-in. dia. bolts. Chord members and web diagonals of the arches have two-piece sections, varying in thickness from 2 to 4 in. and in depth from 8 to 14 in. The web struts are single pieces, varying in size from 4 to 8 in. in the upper portions of the arch to a maximum of 6 x 14 in. at the bottom. All connections or splices are of the lap type, necessitating, at some joints, assembly of seven pieces or thicknesses. Chord splices occur at alternate panel points. Timber is specified to be of dense structural grade (1400#f—1100#c) for the arched truss members, and of non-dense structural grades (1200#f—1000#c) elsewhere. Specifications also require that all timber above the concrete bents be chemically treated for flame resistance.

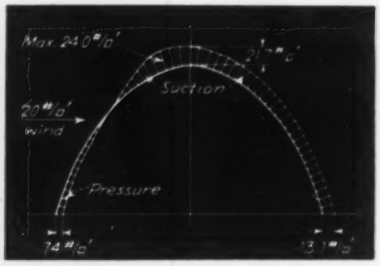


Fig. 1. Distributed horizontal wind load used in hangar design. In addition, a 10 lb. per sq.ft. wind normal to the hangar surface had to be resisted.

Design of the arches is principally predicated upon the wind loads, although earthquake possibilities and snow loads are also taken into account in some localities. The arch outline was obtained from the requirements of clearance and most favorable stress distribution. To assure the latter condition, primary consideration was given to dead-load stresses, in which case the load-pressure line approximately coincides with the neutral axis of the rib, thus resulting in equal stresses for both chords. Under other conditions of loading, such as wind, suctions, trolley hoists and, where applicable, snow and earthquake, the arch is subjected to bending in varying degrees. The arch being of the rigid type, since there is no hinge either at the crown or at the abutments, the analysis included the effects of probable displacement, spread and rotation at the bases, as well as an investigation of secondary stress due to the rigidity of joint connections.

The wind load distribution used in the analysis differs from the conventional horizontal pressures which are normalized by the well-known Duchemin formula. The more correct distribution is the result of extensive experiments on small-scale models in wind tunnels, conducted some years ago in conjunction with the design of the Akron hangar. Assumed values for wind were 10 lb. per sq. ft. normal to the hangar surface (considered either as suction or pressure) plus a 20-lb. per sq. ft. horizontal load, distributed as suction and pressure, as shown in Fig. 1. Earthquake loads are taken as 0.1 g; snow load varies from zero at an inclination of 45 deg. to maximum intensity at the crown; and there is a 5,000-lb. trolley hoist load to be taken into account five panels down from the crown of

the arch on either side. From these loads maximum stresses were determined from one of the following combinations: D.L + wind; D.L + hoist + 0.5 wind; or D.L + earthquake. Maximum stress in the lower chord reached 74,000 lb.

As stated, the concrete A-frames upon which the timber arches rest are one of the significant elements of the hangars. With a vertical inside leg, a battered back leg that is a prolongation of the arch truss top chord, and top and bottom struts (the latter tying the footings together), they are in effect closed rigid frames. Concrete tie beams are placed longitudinally between the frame footings, and these, in conjunction with timber tie beams between the tops of the frames, join all of the frames into an integral and rigid foundation for the arch trusses.

Timber X-bracing placed at intervals between the frames affords additional rigidity; this occurs in 25 of the 50 bays on the line of the inside legs, and in 12 of the 50 bays on the line of the batter legs. In these X-braced bays there is also horizontal X-bracing in the plane of the top of the frames, and the details by which all of these timbers, including the arch trusses themselves, are connected to the concrete, are of particular interest.

As shown in Fig. 2, the basic element of these timber-to-concrete connections is a ⅝-in. steel plate, one end of which is anchored in the concrete while the other end protrudes. Concrete brackets integral with the concrete of the frame legs afford increased section for the necessary anchorage. Since each timber bracing member consists of two 3 x 12's, the protruding end of the steel plate is merely inserted between, and the connection made by bolts and shear-plate-type timber connectors.

The connection of the arch trusses to the bents follows the same general pattern, although two pairs instead of a single plate are required. One pair of these steel plates straddles each of the 4 x 14-in. timbers that make up the truss chord.

The timber hangar design was developed by the staff of the Bureau of Yards and Docks, Rear Admiral Ben Moreell (CEC) USN, chief; Capt. C. A. Trexel (CEC) USN is director of the planning and design department, and Comdr. E. H. Praeger (CEC) USNR is design manager.

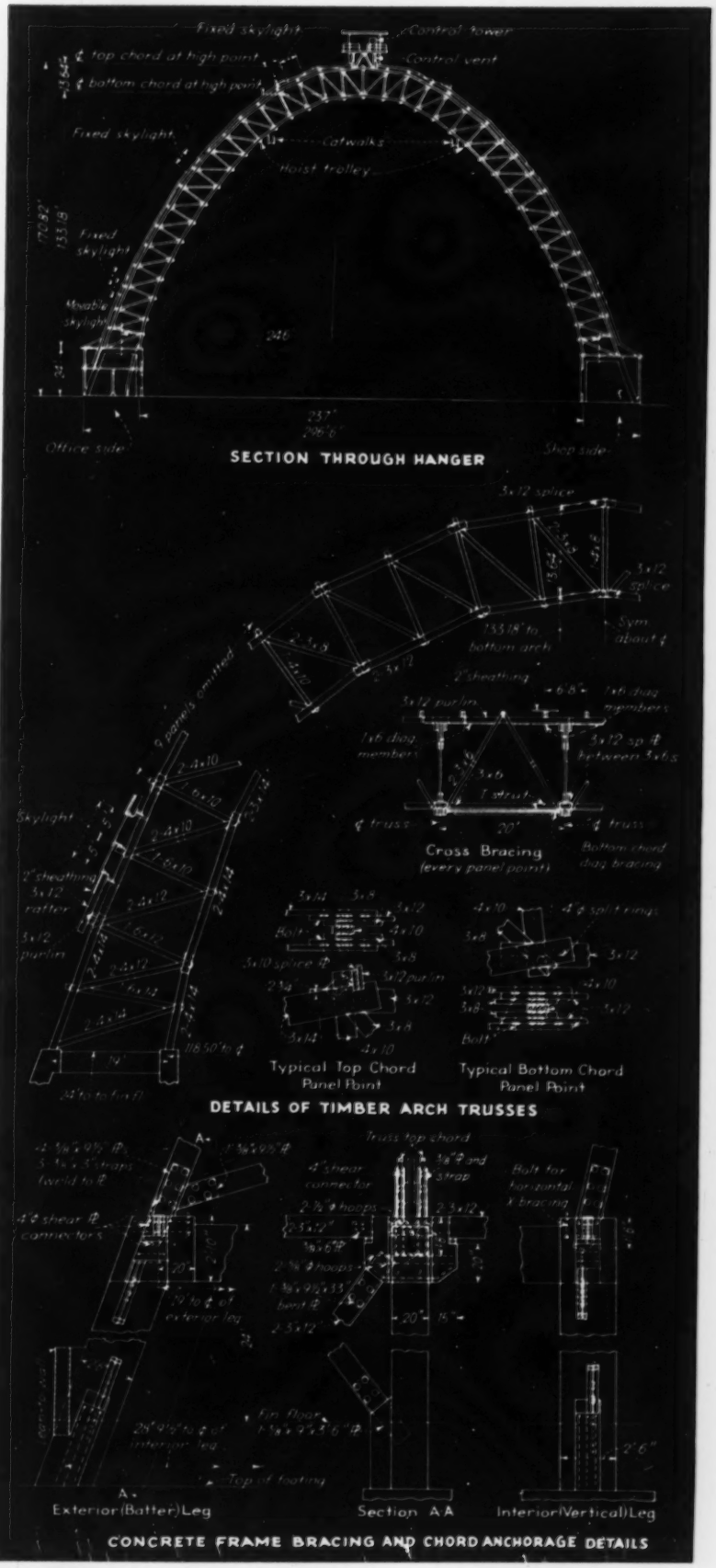


Fig. 2. Details of the 246-ft. span timber arches. The concrete A-frame supports permit a somewhat wider hangar than if the arches rested on the ground.

Auditorium Building Redesigned in Concrete

Walter H. Wheeler
Consulting Engineer, Minneapolis, Minn.

***Contents in Brief**—After foundations were complete, steel for columns, girders, 100-ft. span roof trusses and balcony framing of original design was not available, so a redesign was made in concrete. T-beams of 100-ft. span were substituted for trusses, bar joists for steel purlins. One steel girder was replaced by a concrete girder 10 ft. deep and 18 in. wide. Redesign and new specifications were completed in less than four weeks.*

TO SAVE CRITICAL war materials it was necessary to redesign the superstructure and revise the architectural and mechanical drawings and specifications for a large auditorium building. The problem was greatly complicated because all of the wood piling and concrete foundations were in place and the contractor was proceeding with the construction of the basement walls and first floor when it was learned that steel for the frame, heavy plate girders and 100-ft. roof trusses could not be obtained. The redesign was made in reinforced concrete and, because of the long spans and special framing required, an unusual structure resulted.

The building is about 300 ft. long by 156 ft. wide overall, with a theater, stage and foyer at one end, and an arena, stage and foyer at the opposite end, the two stages being back to back and separated by a heavy masonry wall. On each side of each stage there are three floors of rooms above the first floor, the lower floors accommodating dressing quarters and the top floor housing the heating and ventilating equipment. There is a balcony on each side and across the end of the arena, with utility rooms on the ground floor and toilets on a second floor beneath the end balcony. The balcony in the theater is of the usual type, the front portion being cantilevered over a main cross girder that spans the full width of the theater. There is a second floor under this balcony, part of which is used for public space and the rest for storage and for two exhaust fans that pull the air out of the theater through grilles placed in the lower face or soffit of the balcony.

In redesigning the structure, care was taken to make as few changes as possible in the architectural and mechanical features of the building. None of the latter were altered appreciably and, by retaining the limestone wall facing, the exterior will present the same appearance as was contemplated in the original design. Some changes, however, were necessary in the interior by virtue of the new framing, but it is believed that they are in the direction of improvement, as for example the elimination of exposed steel trusses in the arena ceiling in favor of wide-spaced bar joists between concrete girders.

The two parts of the structure that required the most study were the roof framing and its supports and the theater balcony. Various schemes were given consideration. The roof framing adopted consists of 100-ft. span T-beams spaced about 20 ft. on centers, running transverse of the theater and framed into the columns in the sidewalls. Over the arena, the T-beams in the roof also have a span of about 100 ft., but they run longitudinally. They are rigidly connected to columns where there are columns, but otherwise they frame into cross girders which have spans of 75 and 40 ft. respectively. These beams of 100-ft. span are uniform in section as are also the reinforced-concrete struts that span between them, and between them and the outside walls or wall columns. The T-beams are 6 ft. deep, 42 in. wide across the top and 16 in. wide across the stem. Largest member in the building is the 75-ft. span cross girder (G1) referred to above, which is 10 ft. deep and 18 in. wide. The columns (Col. A) that support it are 36 in. square and carry a maximum load of 506 kips.

The roof beams and girders and their supporting columns are designed so that the contractor can begin their construction as soon as he has completed the first floor. The roof beams can be formed and centered in pairs, thus getting five uses out of the forms and centering; and the construction of the roof framing can be carried forward coincidently with the second floor, balcony and outside wall framing, thus avoiding any delay from waiting for the roof concrete to set enough to remove forms and centers.

The roof beams and girders are designed to take advantage of restraint where they frame into columns, but where they frame into cross girders they are designed as simple spans. The columns are not considered to be fixed at the bottom.

It was found to be impractical to span the theater with a clear span girder under the balcony, and a round steel pipe column filled with concrete was placed at mid-span on the center line of the theater, supported on a new pile and concrete footing. The balcony beams are cantilevered through this girder in the usual way. While this column would have been avoided if possible, its use did result in a considerable improvement of the sight line for the back rows of seats under the balcony, thus compensating partially for its presence.

Construction joints were carefully marked on the structural drawings, and two symmetrically placed contraction joints were placed in each side wall of the arena. These contraction joints extend up through the parapet from the ground level, and measures have been taken to weatherproof them. In the long span roof

beams and cross girders, 4-ft. key sections have been provided at the center of each, so that the effect of shrinkage can be partly eliminated.

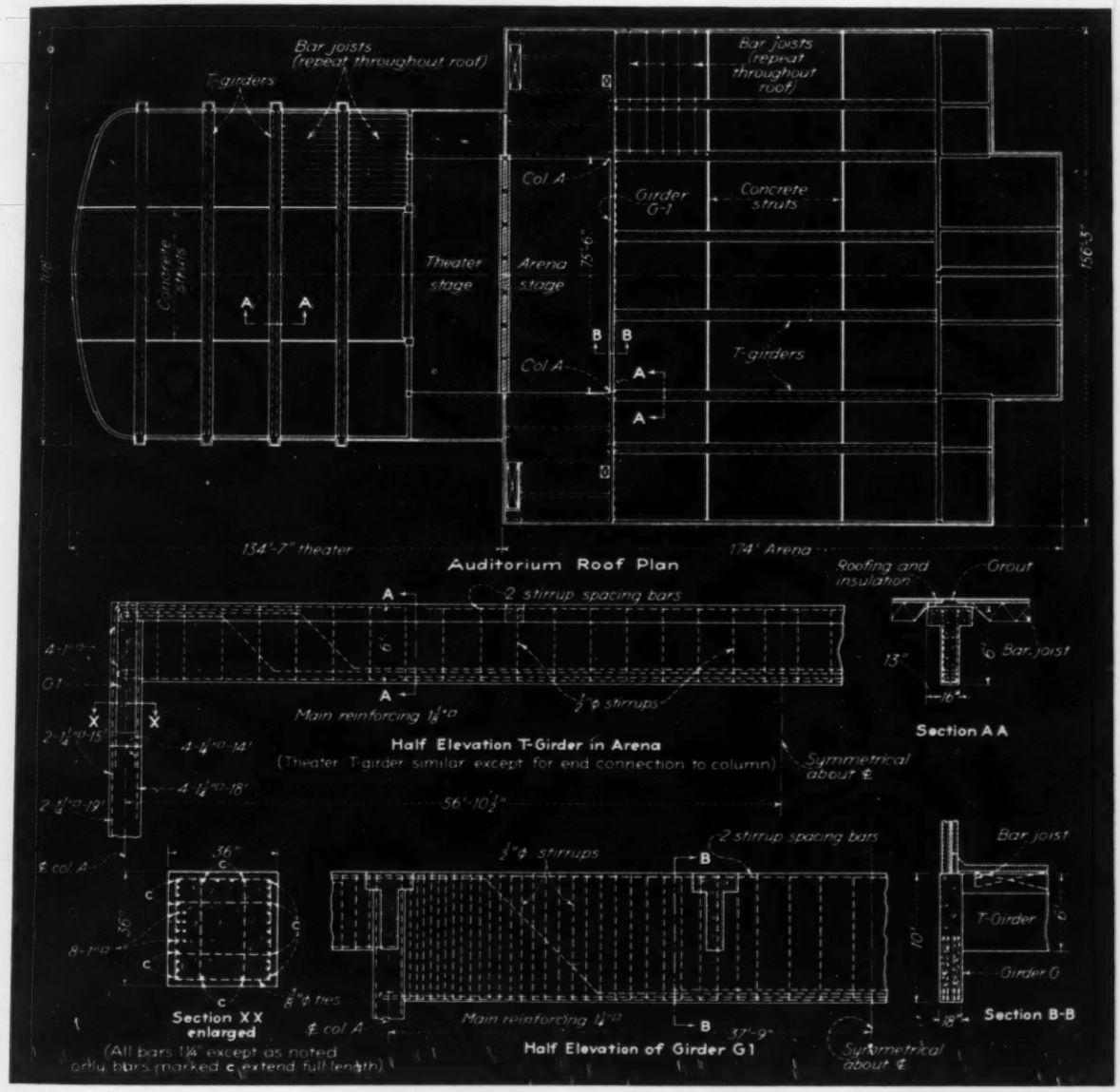
The central portions of the theater and arena floors are supported on concrete piers, which are each carried on a single pile. It was thought advisable to add struts between the piers in the theater floor, and these are placed normal to the floorbeams. The theater floor slab is reinforced with its main steel running in one direction; top steel was added to the slab over the struts at right angles to the main reinforcements. The arena floor is of slab-and-beam construction using a solid reinforced-concrete slab and two-way reinforcement.

The longest reinforcing bars obtainable for the job are 60 ft. Therefore, it is necessary to splice all of the bars in the main roof beams and in the cross girders. A long splice is used, the two bars being wired together and also joined by stitch welding. All splices are staggered.

All of the concrete roof framing, as well as the fourth-floor framing and the top section of all columns that support the roof, are specified to be of light-weight concrete made with burned-clay coarse aggregate. The roofs over the two stages are specified to be of tongue-and-groove gypsum plank, supported on and nailed to precast concrete joists of light-weight concrete. Solid concrete bridging is specified between the joists, the ends of which are built into the walls.

All reinforced concrete in the building above the first floor is specified to be of 3,000-lb. class to keep down the weight of sections.

Approximately 55 percent of the total steel that was required for the original building was eliminated by the redesign which, together with the revision of the drawings and specifications, was completed in just under four weeks.



Plan and structural details of concrete framing for auditorium building incorporating both a theater and an arena. Unusual members are concrete T-beams of 100-ft. span; also the 75-ft. span rectangular girder that is 10 ft. deep.

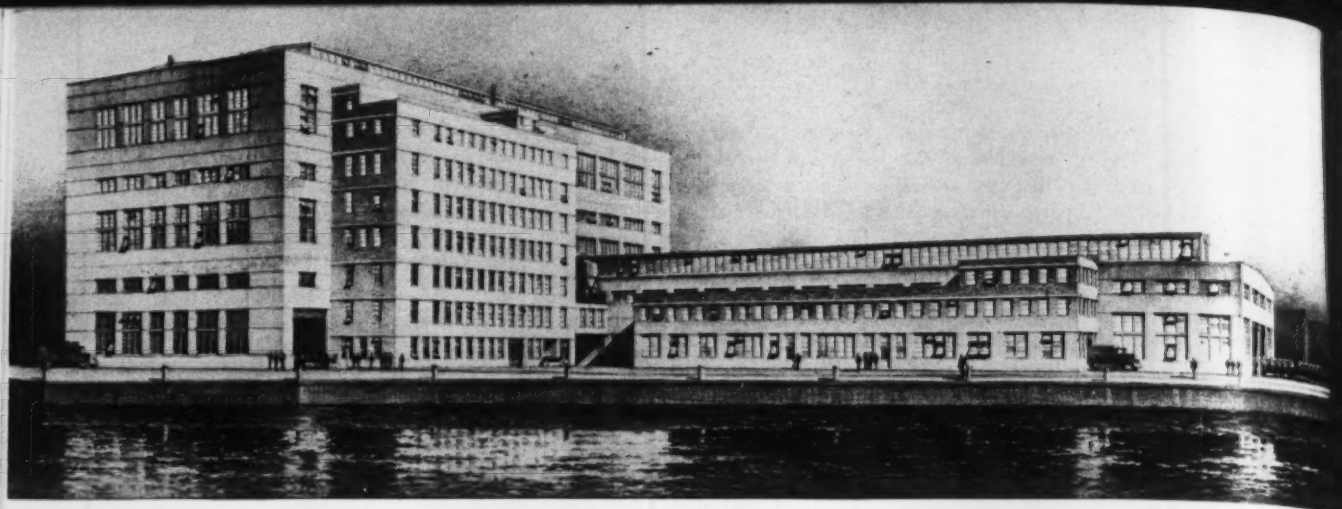


Fig. 1. Timber-framed and with cement-asbestos siding this structure is an outstanding building started in 1942.

Multi-Story Building Designed in Timber

***Contents in Brief**—To save critical materials, a manufacturing and shop building for the Navy, 125 ft. high in three stories, was designed in timber. Timber columns—of small members spread apart and laced to secure better l/r characteristics—shallow wood trusses for heavy floor loads, and plywood plate girders for support of 10 to 20-ton overhead cranes are features of the design.*

AMONG WAR BUILDINGS OF 1942, a manufacturing building at an eastern Navy Yard deserves special attention because it is of multi-story construction and includes not only the more-or-less conventional wood trusses but also laced timber columns and heavy-duty plywood crane girders. Single-story timber factory buildings have become almost commonplace, but a multi-story design can still be classed as unusual. Likewise solid timber columns have been widely used, but the laced variety is only infrequently encountered. Finally, although plywood girders are by no means an innovation, their use in 24-ft. spans to support 20-ton cranes is out of the ordinary.

As shown in Fig. 1, the project consists of a three-story main building, and a one-story wing at right angles thereto. The main building, 125 ft. high, contains two 60-ft. bays spanned by wood trusses that support the upper floors and the roof, while the wing contains a single 96 ft. bay 50 ft. high to the top, also spanned by wood trusses.

Not only did the adoption of timber framing save a large tonnage of structural steel, but by designing columns, trusses and girders so that no piece of timber larger than 4x16 in. nor longer than 24 ft. would be required, conservation of scarce, larger timbers was also effected.

Nor did attempts at conservation stop with the frame. Floors are wood, except those on the ground which are 8-in. concrete. The roof is 2-in. thick precast slabs of light-weight concrete with a built-up asphaltic covering. Wall and roof framing are of wood, with wood lintels over all openings. All window sash is wood, as are all doors, with the exception that fireproof doors are used in inclosed stairwells. Siding is corrugated-asbestos sheathing.

The entire design is based upon prefabrication of units, to enable easy and rapid assembly in place. The crane girders and floor trusses, including an attached portion of the columns, are planned for pre-con-

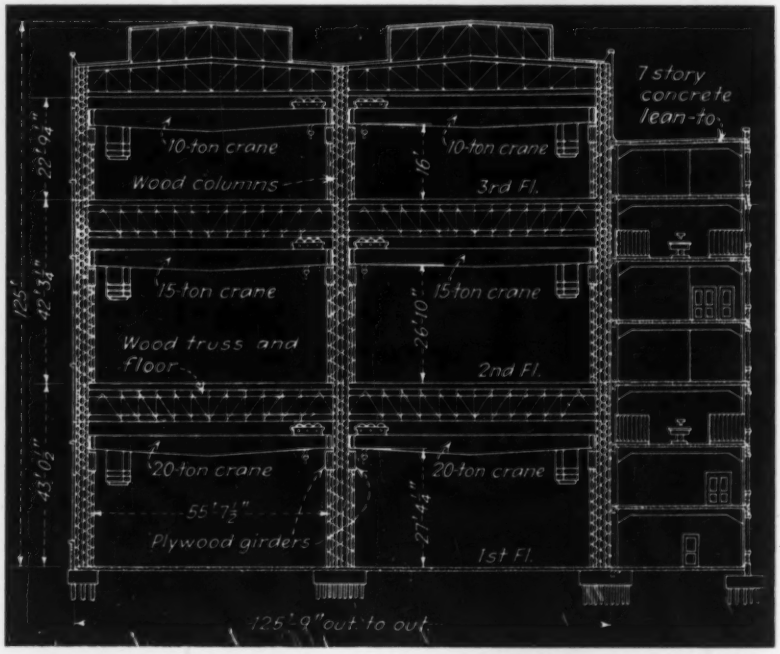


Fig. 2. Section through building shows its unusual makeup. Three-story wood building is higher than seven-story concrete "lean-to" which houses utilities.

struction. The structural columns, which are built in two sections, will be tied together after erection by the longitudinal bracing system at each floor, which in turn is tied laterally to the crane girders, thus creating a continuous longitudinal and transverse bracing system.

Stresses used in the structure are 1,200 psi. in bending, 900-psi. compression parallel to the grain for columns, and 80 psi. for horizontal shear. It is expected that the best available grades of Douglas Fir or Southern pine will be used. Shear-ring connectors, 2½-in. dia. for the plywood and 4-in. for heavy timber, are used for splices and connections in all of the members.

Built-up plywood girders

After the design for the all-timber structure was complete in every detail, sufficient second-hand wrought-iron girders were found for immediate delivery to the project, and the plywood girders were not used. However, since the design was acceptable to the Naval authorities and because it may be of value to others, its details are of interest. Since cranes will operate above each of the three floors in each of the 60-ft. wide bays in the main building and for the full length of the one-story wing, more than 4,000 lin. ft. of plywood girders were contemplated for the project.

The crane girders were designed to be built-up from three parallel pieces of 60-in. wide 1⅛-in. thick 7-ply Douglas Fir plywood, serving as the web and separated top and bottom by 4x8-in. timbers that serve as the flanges. Vertical stiffeners of 4-in. thick timbers are also used between the webs at 3-ft. 6-in. intervals. On top of the beam a 3x16-in. hardwood rail bed is fastened to the girder with glue and lag screws.

The girders, 24 ft. long, are fabricated by the use of split-ring connectors and by gluing all contact parts as they are assembled. A resin bond glue is specified and may be applied hot or at normal temperature for all uses. The ring connectors are uniformly 2½-in. dia., and ¾ in. wide, and are made from ⅛-in. thick material. The ⅜-in. depth to which the rings penetrate the plywood does not damage the material.

The 1⅛-in. thick plywood is made up of four $\frac{3}{16}$-in. plies with the grain running longitudinally, and three ⅛-in. plies with the grain at right angles.

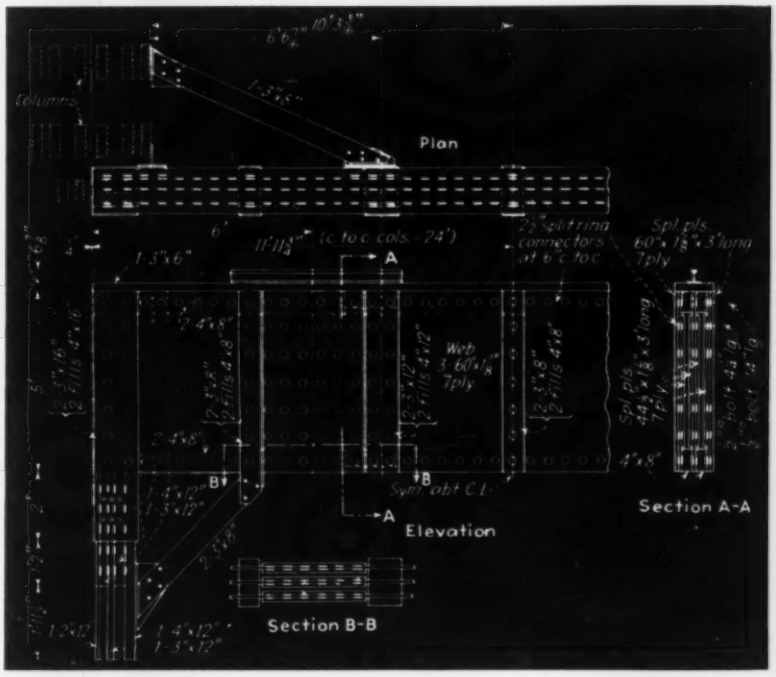


Fig. 3. Details of plywood girder for support of 20-ton crane on 24-ft. span illustrate the use of a triple web and flanges made up of two timbers inserted between the web pieces.

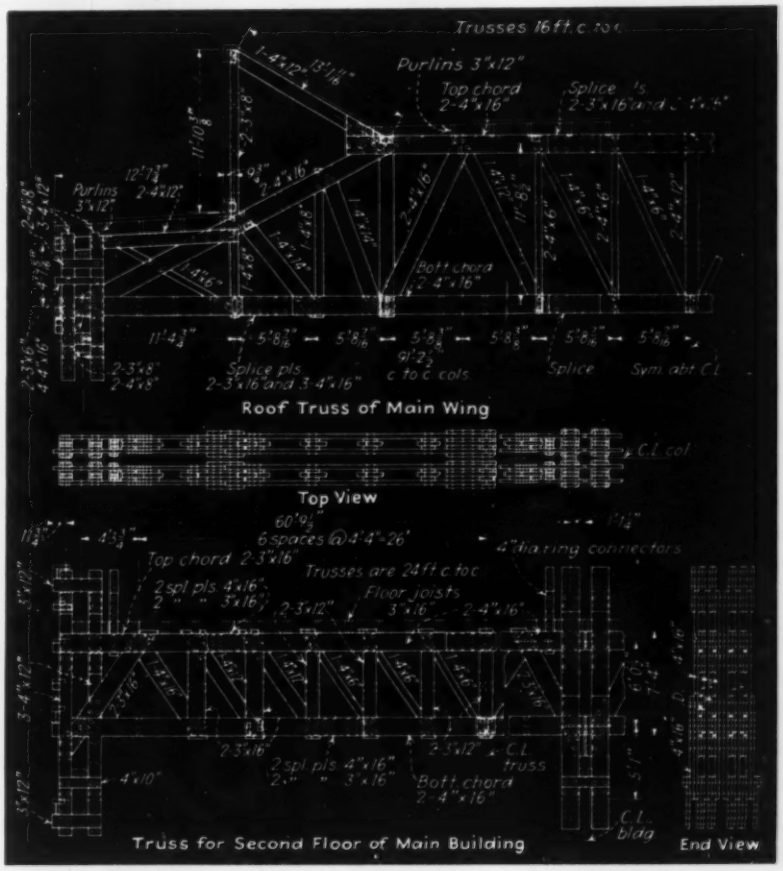

Trusses 16 ft. c to c
Purlins 3"x12"
Top chord 2-4"x16"
Bott. chord 2-4"x16"
Roof Truss of Main Wing
Top View
Truss for Second Floor of Main Building
End View
Trusses are 24 ft c to c
Floor joists 3"x16" @ 2'-4"
4" tie ring connectors
Sym. abt C.L.

Fig. 5. Truss details for main building, where trusses are used in pairs, and for wing, where a single truss is used at each bent. The main building trusses include a section of column, which simplifies erection in the field.

The individual 1⅛-in. thick piece, 60 in. deep, has an effective moment of inertia of 13,500 in.⁴ and a section modulus of 450 in.³ The built-up beam of Fig. 3 has a section modulus of 3,490 in.³ and resistance to shear of 6,500 lb. The strength of the hardwood rail bed is not taken into account in the design.

The 24-ft. long 5-ft. deep plywood girder was designed with the understanding that plywood of that size would be available. It was expected that individual plies would be spliced in the piece but that joints would be staggered so the strength of the piece would not be impaired. However, the maximum length that can be secured at present is 12 ft. so the long pieces are designed for use at the center of the span and are flanked by 6-ft. 3-in. lengths, thus avoiding a splice where the moment is greatest. The splice is designed to be made with additional pieces of 1⅛-in. thick plywood, glued and bolted with split-ring connectors, to develop 100 percent of the full strength of a continuous member. The flanges are single 24-ft. long timbers requiring no splice. The girders designed for the one-story wing are similar in detail but span only 16½ ft. between columns and have the splice 5 ft. from each end.

Shallow trusses for floors

Despite a span of 60 ft. and a design live load of 125 lb. per sq.ft. the depth of the trusses is only 6 ft. c. to c. of chords and 7 ft. 4 in. out to out (Fig. 4). Top and bottom chords are each two 4x16-in. pieces, with verticals two 3x12's or 3x16's. End diagonals are two 3x16's but all others are a single 4-in. thick piece varying from 6 to 16 in. wide depending on its location. For ease in assembly, the truss ends include a portion of the columns, ready for splicing to the lower and upper column sections.

The trusses are used in pairs at the columns, each truss supporting one end of 24-ft. long floor joists. The joists are two 3x16's used together at about 2 ft. 3 in. c. to c. and carry a 1⅝-in. thick subfloor and a 1⅛-in. maple wearing surface. The trusses are stiffened by three lines of knee braces on each side of each truss from the bottom chord of the truss to the joists. One set is located at the center of the 60-ft. span and the other two 17 ft. 4 in. each side of the center.

The roof is supported by a single wood truss at each column. Main

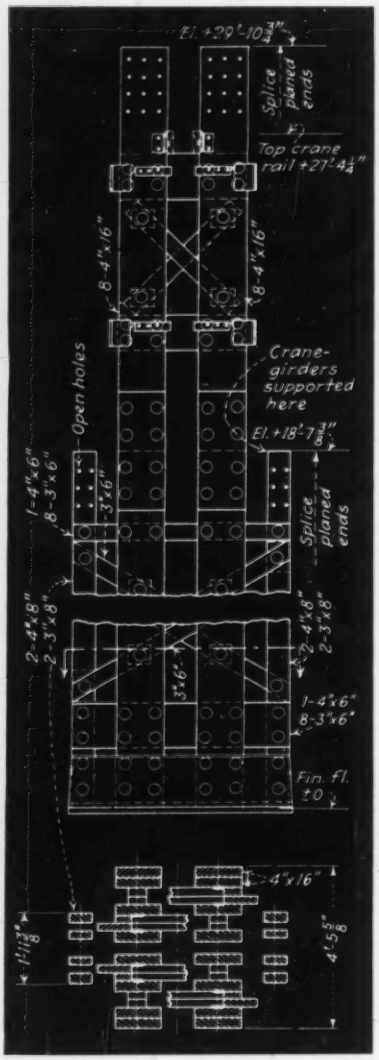


Fig. 4. First-story columns contain 12 vertical timbers spaced and tied together by lacing members. Crane rails are carried on the two shorter supports.

members of the single roof truss are similar to those of the floor trusses, but the top chord is sloped for drainage and also accommodates supports for the monitor. Purlins are pairs of 3x12-in. timbers spiked together at about 3 ft. c. to c., and diagonal bracing is similar to that used on the floor trusses.

The 91-ft. span roof trusses of the one-story wing employ about the same size members as those in the shorter floor trusses, but the depth is considerably greater, 11 ft. 8½ in. Also the ends of the top chords are inclined, an arrangement that permits the installation of efficient light monitors along either side of the wing. A single truss is used at 16½-ft. centers, supporting single 3x12-in. purlins at about 3 ft. c. to c.

High timber columns

Despite the height and the heavy load of cranes and floors the columns for the buildings are of timber, with no piece larger than 4x16 in. The columns are an open-spaced type with ring connectors used at all splices and connections. The open design is used to get greater stability from increasing the radius of gyration and thus decreasing the l/r ratio.

The columns along the exterior of the building are built of 4x12's, twelve pieces in the first story reducing, as the loads become smaller, to only four supporting the roof trusses. The interior row of columns is of similar construction, but all the principal members are 4x16 in. The exterior columns are 4 ft. 4¾ in. wide measured at right angles to the building center line and reduce from 3 ft. 5 in. to about 11 in. in the other direction as the number of vertical members is reduced in accord with the load. The interior columns are 5 ft. 11½ in. wide to the top crane girder while the other dimension varies from 4 ft. 6 in. to 11 in.

Posts for the support of the crane girders are tied to the columns and are included in the overall sizes of the columns given above. These posts are built of two 4x8's and two 3x8's and frame into the end connection of the girder. The posts for the support of the first-story crane start from the foundation slab while those above are framed into the top of the floor trusses that are carried on the main columns.

The columns of the single-story main wing of the structure are a similar, open-spaced lattice-tied design and have an unsupported height to the bottom of the trusses of about 35 ft. The main columns are six 4x16's, and the crane supports are two 4x12's and two 3x12's.

The design for this new industrial plant, including the novel crane girders and column arrangement, was prepared by Alexander D. Crossett, industrial engineer, of New York City. The design described was checked by Lt. Comdr. W. S. LaLonde, Jr. (CEC) USNR, and approved by Commander H. F. Plumer (CEC) USNR, under direction of Capt. W. Mack Angus (CEC) USN Public Works Officer of the yard.

Single-story Concrete Factory —A War-inspired Innovation

***Contents in Brief**—Departing from the conventional, a one-story concrete factory building now under construction costs less than estimates for a similar steel building, requires less steel than a wood truss building, and provides a fire-resistant, low-maintenance structure that is to be completed before steel could have been brought to the site. Design of the permanent structure to accommodate the construction plant is credited with much of the speed and economy achieved. Construction operations are featured by a wheelless traveler, tower-pavers and the use of high-early-strength concrete.*

DUBBED "warspeed" construction because the contractors, architects and owners cooperated so effectively to design a building that could be constructed quickly from presently available materials, a one-story concrete building covering many acres is nearing completion on a 50-day schedule. Despite resort to a type of building not ordinarily built when all materials are readily available, an entirely adequate and economical structure will be obtained.

The building is for the manufacture of a product that requires rows of machine tools and easy access to them. Studies indicated that the best arrangement of machines could be obtained if the span between columns were about 38 ft. thus providing for an aisle or conveyor space and two rows of machine tools in each bay. The projected use requires a 500-lb. per sq.ft. floor load design. It also calls for an overhead conveyor and provision for hanging loads from the under side of the roof. The usual limitations of construction also prevail—lack of all metals, experienced workmen and adequate transportation for men and materials.

Because the contractors, Mahony-Troast Construction Co., were familiar with these needs of the owner and with material and labor conditions at the plant site they were able to suggest a new construction idea for the project. This scheme included the general layout of the building and a plan for economical construction that made the unusual design economical. The designers, Albert Kahn Associated Architects and Engineers, completed the design of the structure, combining the owner's requirements for space and fixtures with the proposed plan for construction. The design selected is a flat roof, single-story concrete structure that uses a minimum of strategic materials and is said to require less steel than a wood building, less ton-mile haul that either wood or steel, and provide a fireproof, bomb-resistant structure at substantially lower cost than for other types of buildings. In broad terms the innovation consists in making the single-story factory entirely of concrete, a material that heretofore has enjoyed its widest industrial use in multi-story construction.

Before the "warspeed" beam and flat slab construction was selected several types of design were investigated. The estimated costs per square foot of floor space for these several types were as follows:

Wood truss with plank roof	$3.478
Structural steel building	3.419
Reinforced concrete with beam and girder construction	3.328
"Warspeed," beam and flat slab	2.911

These figures include all architectural construction, but exclude mechanical and electrical trades, which are common to all types and therefore represent no variation in cost.

The wood truss estimate is based on the cost of a similar though smaller building constructed in the

Fig. 1. Forms in 114-ft. lengths are moved to new position in 3 minutes to speed one-story all concrete building.

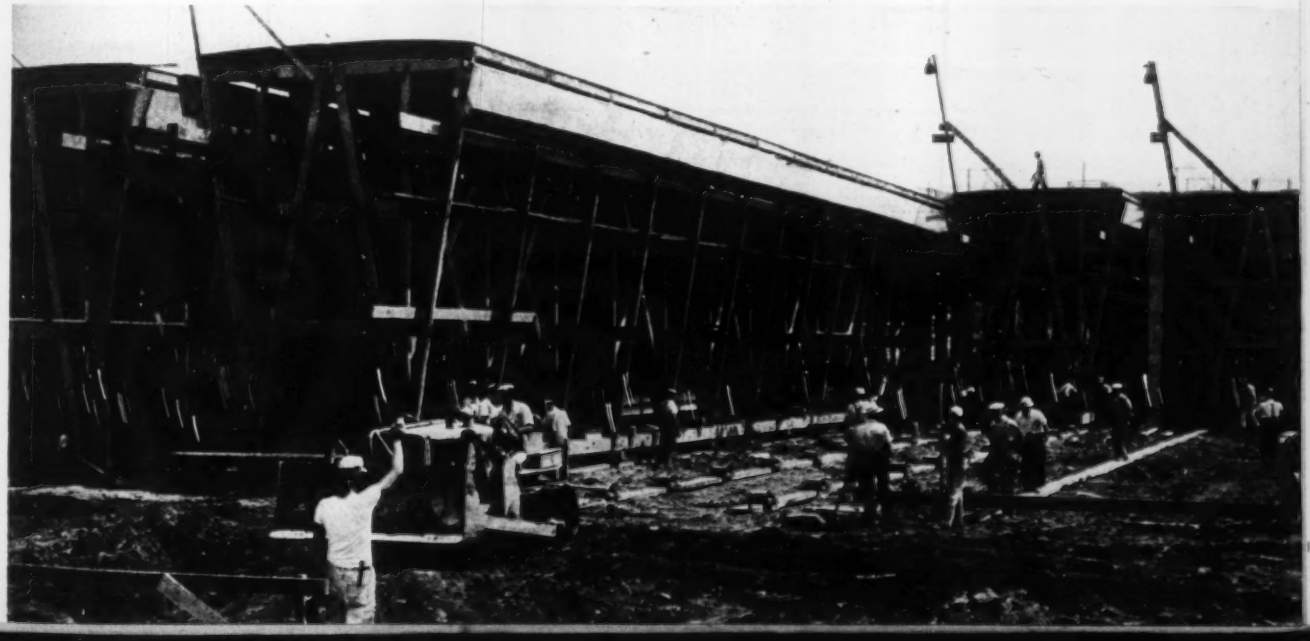


Fig. 2. Bays are 20 by 38 ft. Continuous inserts in beam bottoms will carry 2,000 lb. Hanger inserts throughout the slab will support 500 lb. each.

same area during the last year. The steel estimate is taken from a contract recently made by a nearby plant that supplies similar manufacturing space. The concrete structures are both estimates from plans, but present indications are that the "warspeed" design will be built for less than the cost shown.

The materials required for the wood truss building are compared in the accompanying table with those for the beam and slab concrete structure. The sprinkler estimate is based on full coverage for the wood building and on an average of one head for each 400 sq.ft. in the concrete building. It will be noted that the saving in steel is about 440 tons and in bronze is 7,600 lb. Compared to the conventional steel structure, the concrete building saves 5,200 tons of steel, enough for a light cruiser.

When all of these facts were taken into account the advantage of a concrete beam and flat slab type of construction were found to weigh heavily enough in its favor to warrant its adoption. The structure has 21-ft. clearance under the beams and 20x38-ft. spans. The beams, at 20-ft. centers, support a concrete slab, flat on top and 4 in. thick (for an 8-ft. 10-in. width) at the center, with haunches tapering to 8 in. deep at the beam supports as shown in Fig. 3.

The beams are capable of supporting a load of 2,000 lb. at each of the three "quarter-points" along their 38-ft. length, thus providing for support of monorails or conveyors. The slab has slotted inserts at about 5-ft. centers each way, capable of sustaining a 500-lb. load for supporting pipes or hangers of any type. A 4x4-ft. opening, with curb and drainage protection, is left at the center of each 20x38-ft. bay for ventilators and process requirements. Spacing openings uniformly over the structure eliminated the usual delay incident to exactly locating and forming special sections during the construction.

COMPARATIVE QUANTITIES FOR ONE-STORY WOOD AND CONCRETE BUILDINGS WITH 38-FT. BAYS

Building Material	Bolted Wood Truss Per Sq. Ft.	Bolted Wood Truss Gross	Concrete Frame Per Sq. Ft.	Concrete Frame Gross
Structural timbers	3.05 b.ft.	4,640,000 b.ft.		
Lumber, miscellaneous	2.72 "	4,136,000 "		
Total Wood	5.77 b.ft.	8,776,000 b.ft.		
Reinforcing steel	1.15 lb.	875 tons	3.80 lb.	2,890 tons
Steel plate for truss joints	.87 "	662 "		
Miscellaneous truss bolts, etc	1.72 "	1,308 "		
Nails and Spikes	.10 "	76 "		
Miscellaneous iron	.22 "	167 "	.22 lb.	167 tons
Total structural steel	4.06 lb.	3,088 tons	4.02 lb.	3,057 tons
Steel in sprinkler system	.66 lb.	500 tons	.11 lb.	88 tons
Bronze in sprinkler system	.006 lb.	9,120 lb.	.001 lb.	1,520 lb.

Roof designed to fit forms

The feature of the roof slab and beam design is that it is made to accommodate the use of traveler forms on which the job depends for speed and economy. The beams are somewhat unusual in shape as they are made wider than the supporting column to facilitate moving the forms ahead without interference. For the same reason the beam sides are battered, 1 in. in the 28-in. depth below the haunch, to provide "draw" for easy stripping of the forms. The structure has no projections below the slabs throughout its entire width so that the form travelers can easily move ahead after being dropped only two to three inches.

The bars in the columns, beams and roof slabs are the smallest size compatible with safety and most of them are used without bending. Typical slab steel is $\frac{1}{2}$ in. round bars at 8-in. centers in sets of three across the 20-ft. span. One bar of the set of three is straight throughout its length, and the other two are bent down to near the bottom of the slab at the center of the bay. All bars are purchased and placed in lengths of 60 ft. Longitudinally, $\frac{3}{8}$-in. round bars are used at 18-in. centers for temperature-induced stresses.

Steel in the beams is all straight, except the stirrups. Main reinforcement at the bottom of the beam is two $1\frac{1}{2}$-in. square bars spliced to be continuous through the beam and

over the columns; and two 1⅛-in. bars 27 ft. long in the center of the span. Reinforcement in the top of the beam is three 1⅛-in. square bars 23 ft. long and two 1⅛-in. square bars 17 ft. long, all centered over the columns with no bars in the center of the span.

The columns are a minimum of 21 ft. high and are 18 in. square. They are reinforced with eight ¾-in. round vertical bars tied with alternate sets (each at 12 in. c.c.) of square and diagonal ¼-in. round hoop steel. The columns rest on concrete piers 24 in. square with eight ¾-in. round bars protruding for dowels. Typical footing is a 4-ft.x10-in. square, 2-ft. 3-in. thick block of concrete, with a minimum of reinforcing. Footing sizes are varied to support the expected building load over soil ranging from fresh fill to fairly hard rock.

A basement area of about 300,000 sq.ft. is excavated and prepared for a cafeteria and for locker rooms for the employees. From this section an underfloor passageway extends the full width of the building to provide means of ingress and egress to various parts of the building without going through the plant. Toilets are located under the floor at points such that they are within 150 ft. of every machine. Experience elsewhere has indicated that locating the toilets conveniently thus, rather than on mezzanines, or at distant points, has decreased the lost time, especially among the older workers who must now be depended on for much of the labor in factories. The floor over these basement structures is a heavily reinforced beam and slab design with the 38-ft. span of the general structure divided by addition of column under the middle of the beam.

The floor of most of the structure, however, is an unreinforced concrete slab 8 in. thick laid on the undisturbed or well-compacted ground of the area. The concrete slab is covered with a 2-in. end-grain woodblock floor to make working on the floor less tiring and to preserve the full depth of the slab. Concrete without reinforcing saves considerable steel and leaving out metallic floor-hardener, often used in such work, is estimated to have saved an additional 450 tons of needed metal.

The building is constructed as an open shed, then the floor is paved and brick walls are laid. The speed with which construction started left no time to prepare an underfloor drainage or utility system, so footings were placed and the structure erected with the floors laid at a later date.

The structure is a blackout-type building without windows and will be lighted from fluorescent fixtures hung from the ceiling. Walls are of three-course brick, laid after the concrete frame is completed and the forms moved from the area.

The roof has ¾-in. thick glass wool

Fig. 3. Columns are made narrower than the beams, and the beam sides are battered to simplify moving of forms.

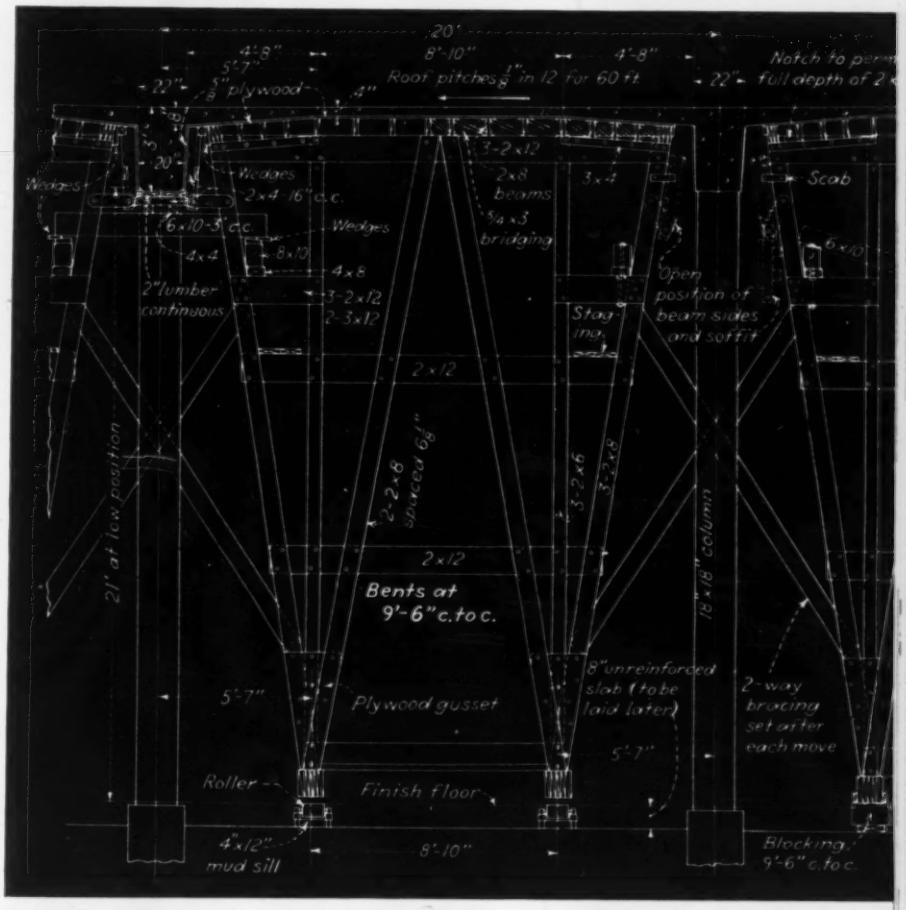
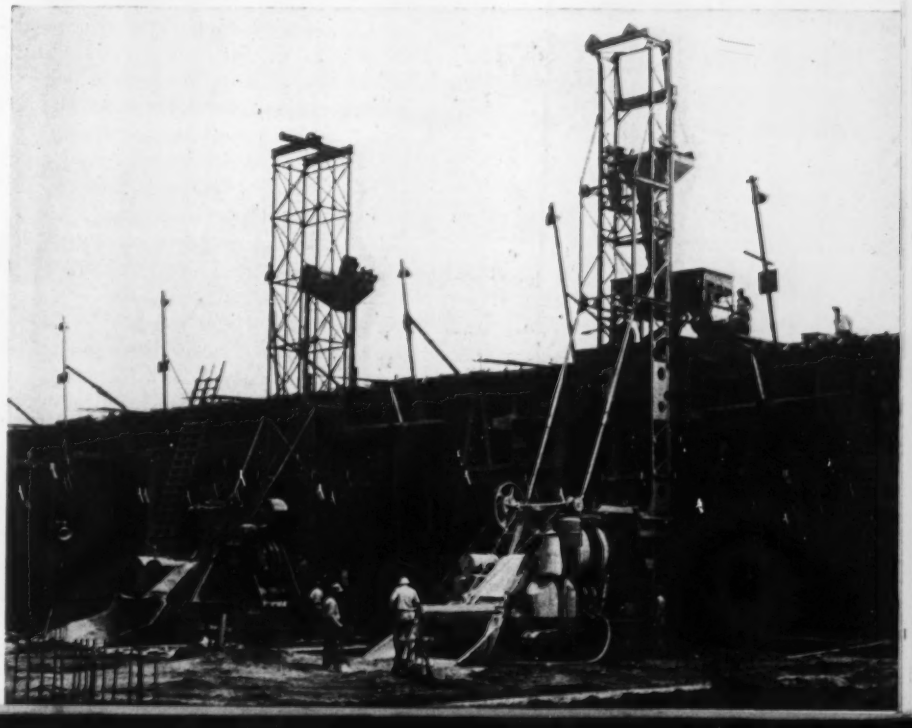


Fig. 4. Tower pavers, fed by dry-batch trucks, mix and elevate concrete to roof for distribution by buggies to columns, beam and slab.



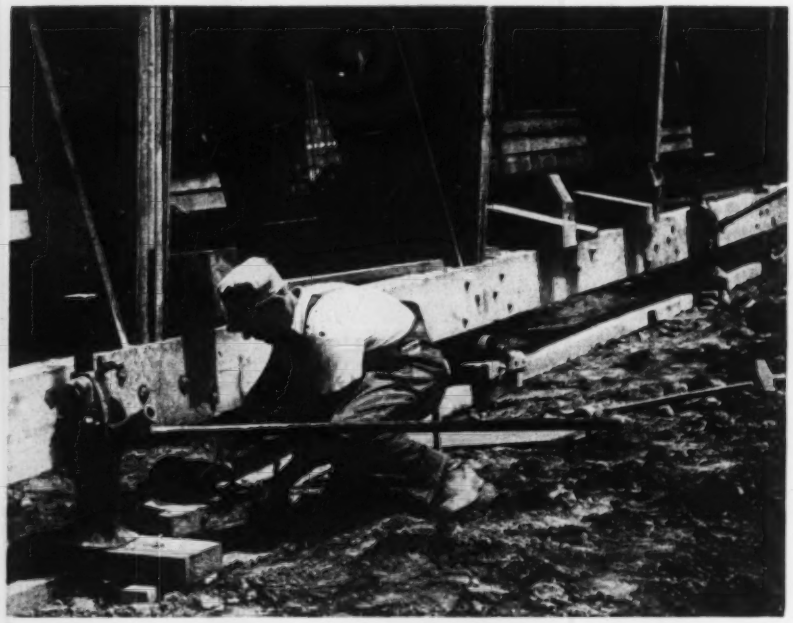


Fig. 5. House movers dollys that can be moved from one traveller to another as soon as the form is advanced save many sets of special wheels and the laying of thirty miles of track.

insulation covered on what is to be the top side by ⅛-in. thick cardboard and bonded to the fiber glass by metal staples held on the opposite side by narrow strips of cardboard. The concrete is mopped with hot pitch, the fiber glass in about 2-ft. by 3-ft. sections laid flat and covered with a three-ply built-up roof.

Roof drainpipes are asbestos cement with their bottoms encased in concrete for about 6 ft. above the floor to protect them from damage by trucks or moving machines. Drain lines under the floor are vitrified clay or concrete, and all of the water supply lines, except those for fire protection service, are non-metallic. Flashings and expansion joints are made of an asbestos material. Ventilation and similar air distribution ducts and cages for unit heaters are made of pressed wallboard.

Other plans considered

The builders, designers and owners jointly investigated other possible construction taking into account all factors that might affect the cost and completion time of the structure.

A wood structure with shorter spans was considered but it could not provide any large saving in timber unless the span would be reduced to 20 ft. or less because that dimension is the maximum standard length of lumber ordinarily available. However, a 20-ft. span involves waste of space in double aisles so that fewer machine tools can be installed per 1,000 sq.ft. of floor space than if there is 38 ft. between columns.

To minimize the requirements for metal plates in the wood structure lattice trusses 38 ft. long were considered. This change would reduce the steel to not much more than the reinforcing for a concrete building plus the miscellaneous iron and sprinklers. By suitable location of the supports the roof could be constructed from 2x4-in. pieces set on edge and spiked together to provide a deck 4 in. thick. This type of construction is more resistant than the trusses to penetration by incendiary bombs but the latter can be more readily attacked by fire than the truss which utilizes heavier wood timbers. The lattice design requires more manhours of work and a larger quantity of wood and therefore suffers by comparison with the truss type.

In designing wooden structures, care was exercised to see that the number of bolts utilized in the joints and other connections was held to the bare minimum. The architects made special tests in the Wood Structures Laboratory of the U. S. Forest Service to determine the minimum number of bolts required and substantial savings in the use of steel were thus effected. The timber design used for comparison was simplified by elimination of hanging any substantial load from the overhead structure, floor conveyors being planned to take care of the movement of all material.

Wood was found undesirable for roof decks as it seemed best to provide improved safety against fire and incendiary bombs. The type of "gypsum plank" often used in this work incorporates metal edges made of galvanized sheet steel that weighs 1.63 lb. per sq.ft. and seemed to eliminate this class of material from consideration under the present circumstances. The use of a poured gypsum roof also appeared to be ruled out for present use because of the necessity for reinforcing rod or mesh in this kind of construction.

The use of a precast concrete tile roof was not believed to be satisfactory with wood purlins because any warping of the purlin results in a "step" in the roof deck at the joint. This might cause a break in the roof covering and consequent leakage into the working area.

Carpenters and lumber scarce

Inquiry into the labor situation in the area where construction was contemplated revealed that the carpenters' union was not in position to supply the required number of men required for the size project contemplated if a timber design were used. Carpenters would have to be brought to the area and it was not certain where, or even if, they might be secured. Inquiry at several mills showed that orders for heavy timbers and planking being currently placed by the government made delivery of the required quantity of lumber doubtful.

The lumber required would fill about 440 railroad cars at an average of 20,000 b.ft. per car. As all of this material would have to come at least from the southeastern states, it would impose an additional large load on the railroad system. Contrasted to the lumber, all the aggregates and cement for a concrete building could be obtained from nearby sources, imposing little additional burden on the long haul transportation system.

The heavily reinforced, thin-shell barrel-arch and inverted-beam design of concrete roof construction was considered but found less desirable than the type adopted. According to the owner's design summary, the arch form of roof is not well suited to the suspension of pipe, conduits and con-

veyors required in factory practice; the curved beams required a complicated reinforcing pattern; the sloping surface of the form for the roof arch makes it both difficult and expensive to place reinforcing steel and prepare the forms; and the regular wave appearance of the arch roof makes it difficult to conceal the structure from the air.

CONSTRUCTION PLAN AND PLANT

Because, as previously stated, the design was in large measure predicated upon the constructure procedures to be used, field plan and methods are of uncommon importance in the story of this "warspeed" building. Three basic elements are to be noted: use of a traveling form that could be rapidly set in position and as readily stripped as it was moved through the building from one end to the other; delivery of all concrete above the ground with hoist towers mounted on paving mixers; and the use of high-early-strength cement.

The contractors set up the schedule for concrete placing on the basis of a six-day cycle for each form. This permits two days for curing, say Monday and Tuesday, after which the form would be moved to its new position and assembled on Wednesday; on Thursday the column forms would be set and reinforcing started; Friday the concrete would be placed in the columns and the reinforcing completed; and on Saturday the slab and beam concrete would be placed. Once the job was well organized and moving, the cycle was cut to five days, then four and even to 3½ days in some instances. Most of this gain in time came in speeding form moving and setting and placing reinforcing.

The desired early moving of the forms could be met either of two ways—by expensive and not very dependable reshoring of beams and slab or by use of high-early-strength cement for the concrete. The reshoring would slow or hault installation of subsurface facilities or require an entirely different scheduling of the work. Naturally, the contractor chose the early-strength cement as being more economical as well as of tremendous advantage to the speed of the job.

Regular work schedule is a sixty-hour, six-day week but if a day is lost, for bad weather or other reasons, it is made up on Sunday. The management feel that fully as much work is accomplished in six days as in seven and the cost is much less. Two ten-hour shifts are worked on most of the construction operations.

General plan of construction was to provide a complete set of traveling forms in each of the sixty-nine 20-ft. wide bays of the building. The length of these travelers was determined by the speed necessary in construction. The contractor offered the owner the choice of ten uses of the forms and 50 days of pouring concrete with a form three bays (114 ft.) long or fifteen uses of each form and 80 days for actual concrete placing with a form two bays (76 ft.) long. The shorter time was accepted to speed completion of the vital war factory, forms being built to the design shown in Fig. 3.

The traveler frame is built of moderate size timbers, readily available from local lumber stocks, and uses plywood gussets for connections. The forms, all of ⅝-in. plywood are attached directly to the frame.

No rails for the traveler

The traveler form for the beam and slab contains several innovations. First, no rail is laid for the traveler. Instead, a 2x12-in. continuous mud sill is laid, and leveled to a reasonable degree of smoothness, with extra blocking for added support across soft spots. No wheels are provided on the travelers, instead they roll on house-mover's "dollys" laid upside down on the mud sills at 9 ft. 6 in. c. to c. These rollers do not move ahead with the traveler but merely support it as the 114-ft. long frame moves along.

The traveler carries the beam side and bottom form in hinged position so that all pieces are always kept together and moved ahead at one time. When the form is prepared for concrete placing, a retractable timber member is placed across the opening between two travelers and wedged up to take the load of the beam.

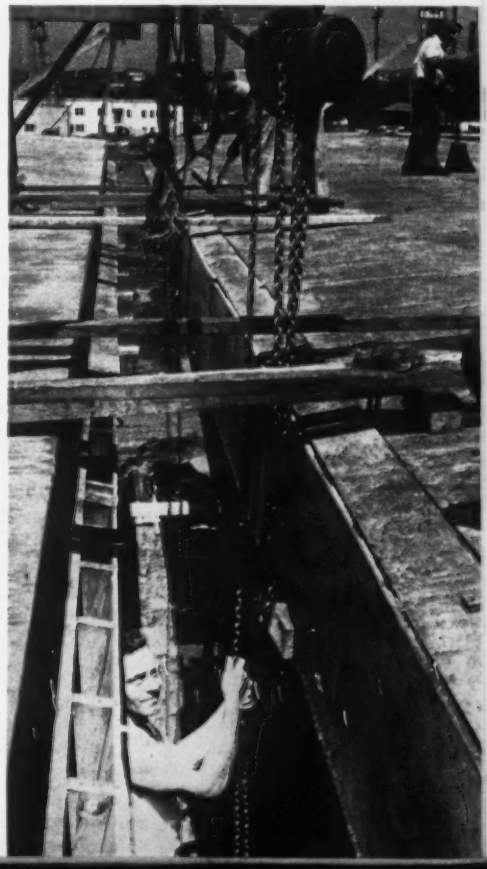
Pairs of large wood wedges, at 9 ft. 6 in. c. to c. under the bents of the traveler frame carry the load of the form while concreting is being done and during the curing period. When stripping starts the rollers are set on the mud sill under the traveler, the beam supports are loosened so the soffit and beam side forms are free and then track jacks are used to lower the frame to the rollers. A small tractor is used to pull the form ahead to position for its next use.

Frills eliminated

When the design for moving the traveler was made, special guides and greased rubbing strips were provided to keep the traveler to proper line over the mud sills and rollers. When actual formwork started an experienced building mover was secured to supervise that operation. Following building moving practice, he eliminated the guides and depended on "cutting" (changing to a slight skew) the rollers as required to keep the form moving in the correct line. Actual moving time is 1½ to 3 minutes for the 114-ft. travel to the new position. Horizontal variation from the proper line for the form is seldom more than 1 in.

When in position, the traveler is raised to the proper elevation by

Fig. 6. After the traveller is moved the side of the form, dropped for moving clearance, is raised to position by chain hoist. No rebuilding of forms is required throughout the job as the only piece ever damaged is a narrow strip on top of the drop section.



track, screw or hydraulic jacks set under the main bottom longitudinal members. Where necessary, the horizontal alignment of the traveler is corrected by pushing it sideways with jacks blocked against the footings. The beam form is raised to plan and grade by a chain hoist (Fig. 6), and wedged up.

Another innovation in traveler use is erection and support of the column form and placing of the concrete from the frame of the traveler. The forms for the 21-ft. high columns are of ⅝-in. thick plywood in four individual pieces backed up by 1x4-in. battens laid flat. The forms are disassembled after each use, then put together and laid on the traveler to move ahead. After the traveler is solidly set up a block and fall is attached to the frame and used to lift the column form to position. A following crew puts steel column clamps on the form at 7 to 12 in. c. to c. and the reinforcing steel, assembled into a cage on the traveler deck, is dropped in from the top. Concrete is wheeled over the form to pour the columns well in advance of the deck concreting.

Concrete by tower paver

A battery of four 27E pavers mix the concrete for the columns and roof and deliver it by tower hoist, mounted on the mixers, to buggy loading hoppers located at the front of the forms. The pavers were selected for their mobility, economy and capacity to produce concrete when and where wanted. The full line of 69 sections of traveler forms advances across the building area, and as concreting is completed in an area six 20-ft. wide bays the paver moves to another position. The pavers can move rapidly to any part of the work where they are needed but their use is confined to the slab concrete and the moves are short.

Curing of the slab is done with heavy cotton mats laid on the concrete as soon as it attains the initial set and kept wet for a minimum of four days time. When the mats are wet they are quite heavy and are moved by putting them in a concrete buggy for transfer over the slab.

The floor slab is an unreinforced 8-in. thick layer of concrete placed directly on the subgrade except over the basement and toilet areas where heavily reinforced beam and girder construction is used. Almost every bay of the building has some subsurface piping so that paving the slab was delayed until complete plans were made available and the piping could be laid. This precluded any idea of

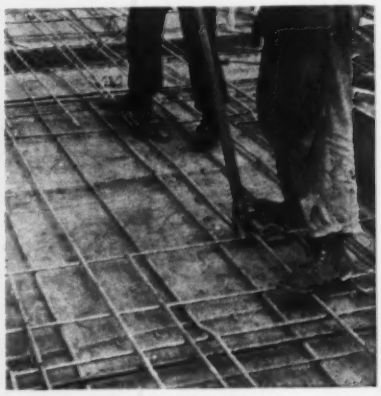


Fig. 7. Slab steel is laid in straight lengths and bent in place as required.

paving the area ahead of placing the columns and roof.

Truck-mounted mixers are used for placing all concrete on or below the ground. The mixers are driven in under the finished roof slab and discharge the concrete directly into place where it is leveled and screeded by hand. Concrete used for the floor slab (and all concrete below the ground) is made with standard portland rather than with high-early-strength cement.

Securing materials for 300,000 cu.yd. of concrete in little more than two months time introduced a special problem. Many usual sources of concrete materials in the area were already producing at capacity and the smaller plants still available were not individually capable of guaranteeing sufficient deliveries. The contractors for the project arranged a combination of six nearby sources of supply for natural sand and crushed stone aggregate. One size of sand is used and only one size of crushed stone (¾-in. maximum) all of which is trucked to the job and stockpiled near the batcher plants by driving onto the pile. Bulk cement comes to the job by rail in hopper bottom cars.

Two batching plants

Dry batches for the 1-cu.yd. pavers (actually about 29.7 cu.ft.) and charging of the 5-cu.yd. truck-mounted mixers demanded two separate batching plants, especially as the batching requirements for concrete materials exceed the capacity of a single set of weighing scales.

The two plants can each be used for "one-shot" batching up to 5 cu.yd. of material and are both equipped with automatic water-weighing devices for charging water directly into the drum of truck mixers. Batchers in the two plants are identical, having four-beam, manually operated scales for cement and three aggregates (only two aggregates are used at this set-up, however).

Bins are the usual demountable steel type with some bulk cement storage above the batchers. Aggregates are fed into the bins with clamshell buckets on crawler cranes with material in the stockpiles being pushed within bucket range by bulldozers operating over the piles. Cement is taken from the hopper-bottom rail cars by screw conveyors and then by bucket elevator to the bin over the batcher, or to lower level storage bins. Cement from the storage bins is reclaimed as required by the same screw-conveyor, bucket-elevator system.

The cement storage "silo" at one of the plants is a discarded water tank that holds 450 bbl. of cement. Its procurement saved new plate and a wait of several weeks for delivery.

The two plants are capable of batching 120 cu.yd. per hour into the batch trucks and 150 cu.yd. per hour into the 5-cu.yd. truck mixers respectively. This theoretical capacity of more than 5,000 cu.yd. per 20-hour day has exceeded the maximum demand through most of the construction period.

The general design for the building and its construction was conceived by Paul L. Troast of Mahony-Troast Construction Co. and he has been in general charge of the work. Wm. C. Troast is project manager; C. S. Evans is general superintendent of field work, assisted by area superintendents Joseph A. Bryant and Alfred A. Thomas. W. C. Sheppard is in charge of the concrete plant.

For Albert Kahn Associated Engineers and Architects, Inc., Fred Guenot is in charge of the work in the field.

The structure is being financed and built under the general supervision of the Defense Plant Corporation of the federal government. Geo. T. Lucas is division engineer for the D.P.C. and Carl Meiselman has immediate supervision in the field.

In the interest of national security the location and the name of the operator of the plant must be withheld.

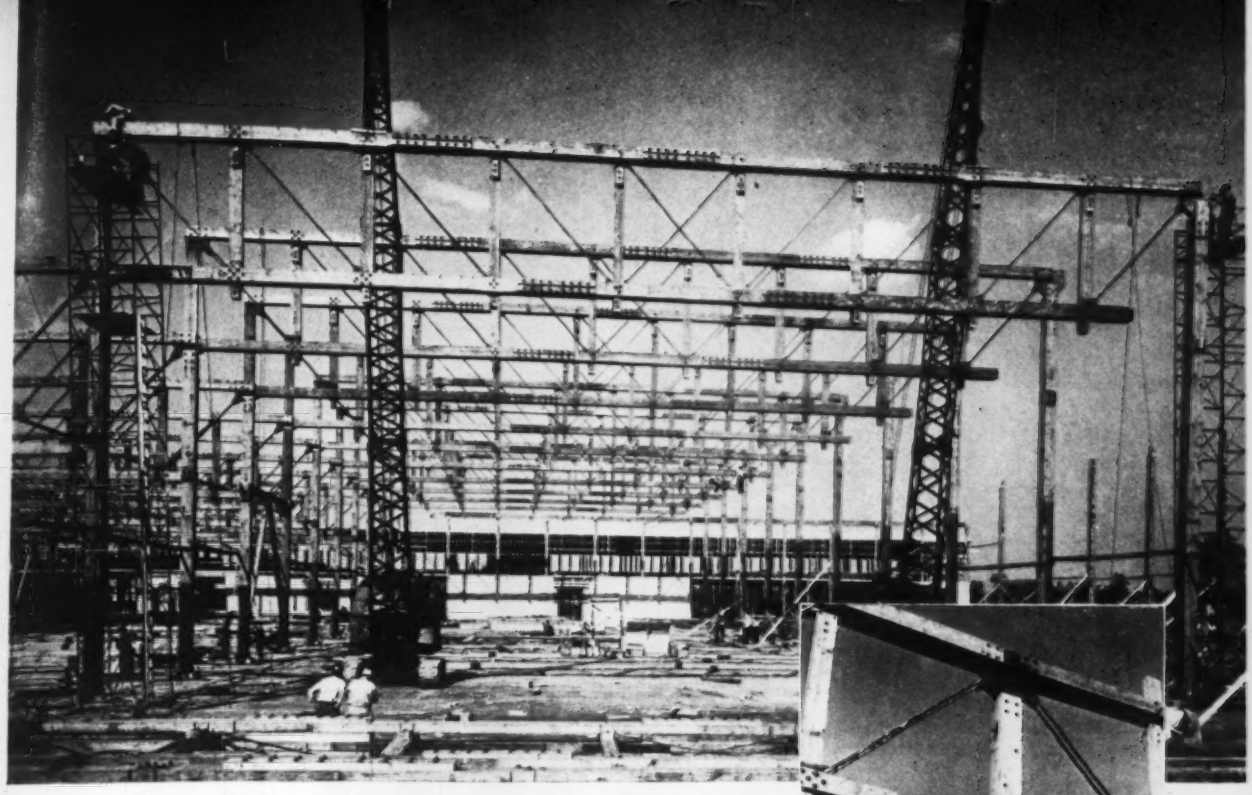


Fig. 1. Steel diagonals in 99-ft. span timber trusses are used to permit passage of maximum amount of natural light in aircraft plant sawtooth roof construction.

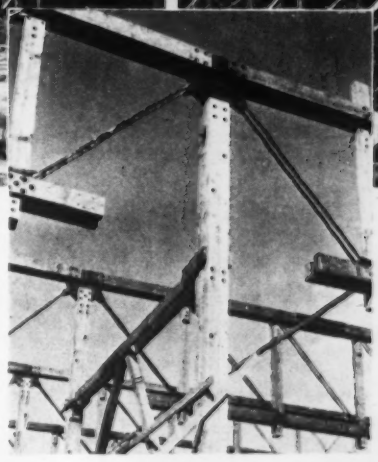


Fig. 2. Timber trusses are spliced over columns by bolting both trusses to single gusset plates. Note grooves for ring connectors where lower chord splice will cross column.

Timber Trusses with Steel Diagonals

A STRIKING EXAMPLE of the use of prefabricated structural timber is afforded at a large aircraft plant nearing completion in eastern Canada. The production floor of this factory has eight bays 99 ft. wide with columns 30 ft. apart in the other direction. A sawtooth roof, framed into the main trusses, provides natural light throughout the plant.

Main trusses, of 99-ft. span, have top and bottom chords of two 6x14-in. timbers, with verticals of single 6x10 to 6x14-in. pieces between the pairs of chord members. The diagonals are pairs of square rods welded into slotted gusset plates that have flanged shear plates welded to them for connection to the timber truss members. Split-ring connectors and bolts are used for all wood-to-wood connections.

Steel diagonals are used to permit maximum passage of light through the side of the truss, which is used here as the vertical of a sawtooth roof. Sash is carried on one side of the truss as shown in Fig. 3. On the sawtooth trusses, which frame into the main trusses at right angles, is a 3-in. thick spruce deck covered with white asbestos-cement shingles that reflect additional light into the building.

Columns are formed with two pieces of 6x16's and one 7x16, the latter being in the middle. The members are made into a laminated unit by inserting ring connectors and drawing the pieces tightly together with bolts. Throughout most of the factory the columns have an unsupported height of 22 ft. to the underside of the trusses but this is increased to a clearance of 35 ft. under the trusses in the foreground of Fig. 1. The columns extend to the top chords of the trusses, which are spliced on a single gusset plate at that point.

Over 1,000,000 b. ft. of Douglas Fir timber were required for the structural frame, and more than 100,000 ring connectors were used. The complete frame was accurately prefabricated at a West Coast plant and shipped to the site, knocked down and marked, ready for assembly and erection.

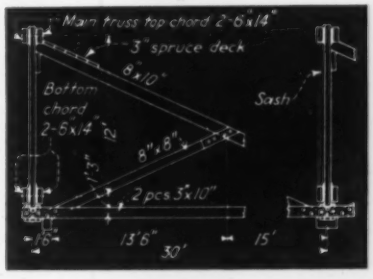


Fig. 3. Sawtooth roof is formed by long timbers framed into main truss at each panel point (11 ft. c. to c.).

T. Pringle & Son, Ltd., were the architects and engineers; L. G. Ogilvie & Co., Ltd., were the contractors, and Canada Creosoting Co., Ltd., were the fabricators of the trusses. Home offices of these firms are in Montreal.

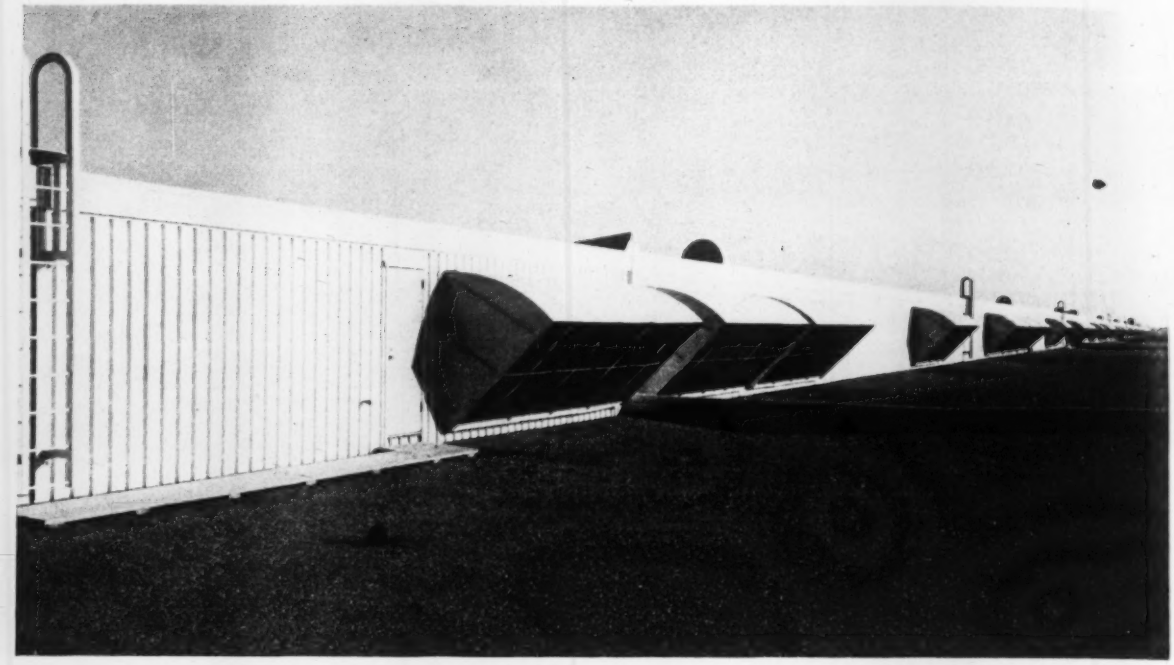


Fig. 1. Fresh air is taken in and used air exhausted through these hoods, which are equipped with blackout light traps.

Air Conditioning a Giant Aircraft Plant

***Contents in Brief**—In constructing an aircraft parts and assembly plant an air-conditioning system serving a tremendous floor space was required. The system will supply 4,360,000 cu. ft. of air per minute, including 18 percent of fresh air. The quantity of water cooled and recirculated between the coolers and the air-conditioning coils totals 26,000 gpm.*

WHAT IS BELIEVED TO BE the world's largest industrial air-conditioning system is now being installed for a huge aircraft parts and bomber assembly plant built for the U. S. Army. The giant plant includes a parts section now under construction and a completed main assembly building to which are attached a boiler house, maintenance and other shops and an engineering office.

When completed, the air-conditioning facilities will include 87 centrifugal-type fans, and it will supply conditioned air at the rate of 4,375,000 cu.ft. per minute. At all times the conditioned air will contain 18 percent fresh air brought in from the outside.

The total installed refrigerating capacity is 12,375 tons of cooled water, the temperature of which is reduced by means of twelve steam-driven centrifugal refrigerating compressors. These units consist of eleven 1,075-ton compressors operating at 3,210 rpm. and one 550-ton unit at 4,200 rpm. The cooling medium will be Freon 11.

The compressors are directly coupled to the turbines, which at peak output will require a total of 173,100 lb. per hour of dry saturated or non-superheated steam at 215 psi. Vacuum in the steam condensers at this peak load is maintained at 26 in. of mercury by using water from a nearby lake for condenser purposes. In the summer months this water may be delivered at temperatures as high as 85 deg. F., and for maximum demands 30,000 gpm. will be required.

Arriving at the plant, the water will be pumped through the refrigerating and steam condensers in series. The discharge water will be returned to the lake by gravity at a

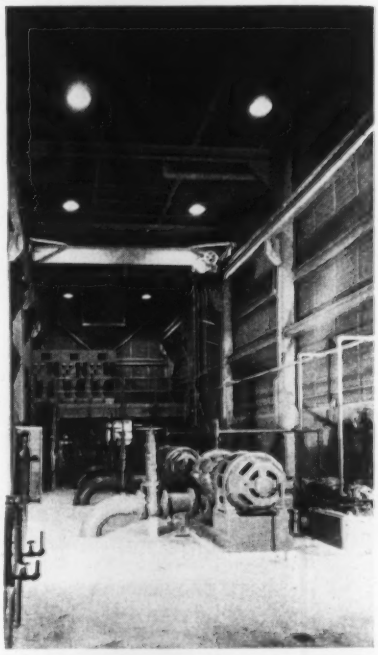


Fig. 2. Water for the air-conditioning and fire protection system is provided by three motor-driven, centrifugal pumps, total capacity of 30,000 gpm., located in a special structure. The plant's water supply is a large lake.

point about one-half mile from the intake location.

During the summer months water will be cooled and recirculated between the water coolers and air-conditioning coils at the rate of 26,000 gpm. in extreme weather.

Winter requirements

In winter or when the outside temperature falls below 45° F. steam from four gas-fired boilers will be used by heat interchangers to provide hot water for circulation to the various parts of the building. Each of the boilers will deliver 100,000 lb. of steam per hour at 225-psi. pressure with no superheat, and the boilers are provided with emergency fuel oil feed systems. The hot water is to be distributed through the same piping as the chilled water when cooling is required.

Heat will be required only for warming fresh air brought in from the outside. No heat will be needed to meet losses through the walls and roof of the buildings as the heat given off by the plant population, the lighting units and other equipment is estimated to be sufficient to offset the maximum loss. This loss is expected to be low as the result of special side wall and roof construction, in which alternate layers of steel and glass wool have been employed with special vapor seals.

Distribution duct totals 18 miles

About 18 miles of distributing duct was required for the entire system serving the parts plant, assembly building, maintenance shops, offices, cafeterias and hangar. Most of the ducts are of sheet metal, as they were ordered many months ago, before steel became so critical. Distribution through all of the ducts is automatically controlled at a 23-ft. central panel in the boiler house. For speed and reduced cost, standardization has been followed wherever possible in the fan and duct systems. In one of the buildings 19 fan and duct systems are exact duplicates and 15 are alike in another.

In the assembly building, as shown by the accompanying illustrations, the units are located on platforms supported on the bottom chords of the deep trusses spanning the wide main longitudinal bay. Each of these units consists of two fans, air conditioners, air filters, coils, main ducts and outlets. In the parts plant direct steam heat coils are used in the same housing as those employed for the cooling coils.

For the Army, the U. S. Engineer Corps is in charge of construction. Because of military restrictions mention cannot be made of the builders and the engineering firm that designed the air-conditioning system for the plant. Neither can the general location of the plant be made known at this time.

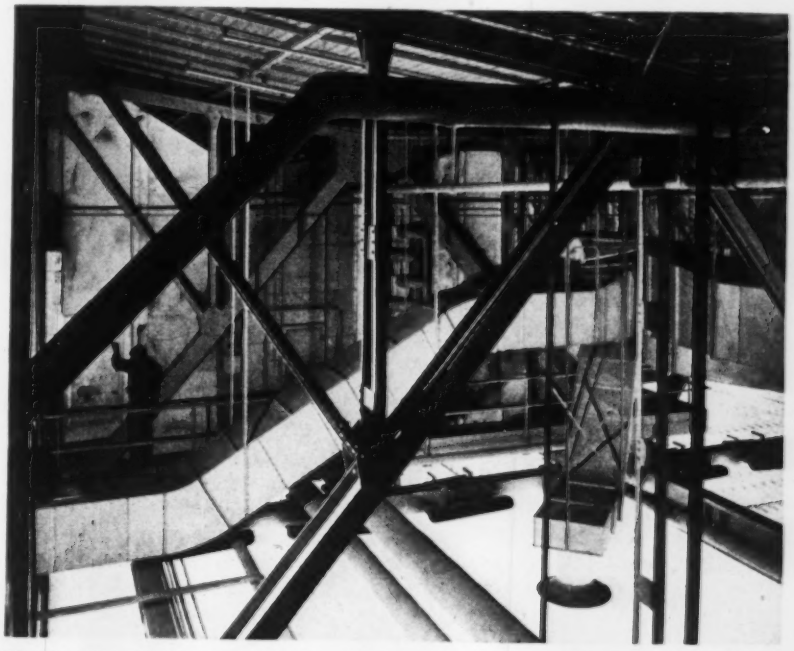


Fig. 3. Air-conditioning units for the assembly plant are supported above the floor level on the lower chords of the deep roof trusses spanning the main longitudinal bay. By means of ducts branching out in all directions, each unit serves a large area of floor space.

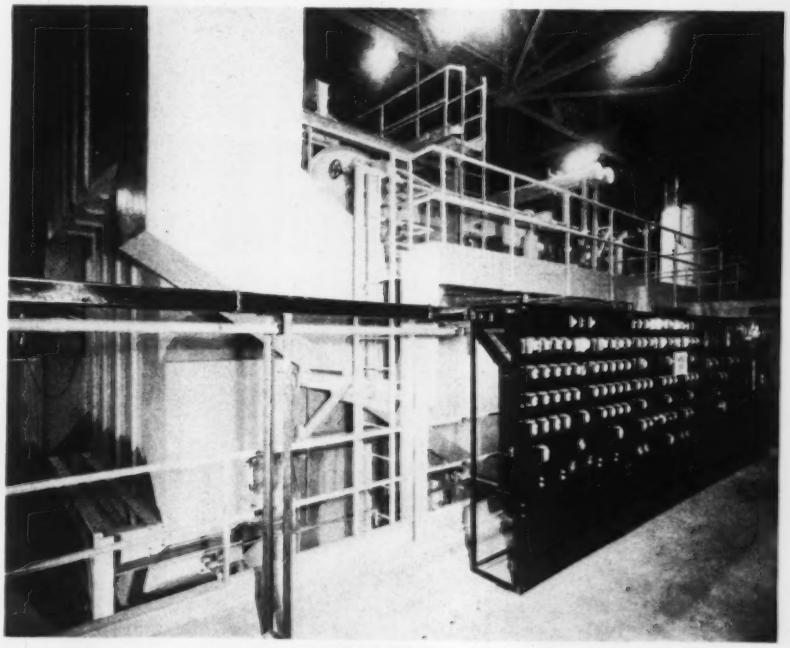


Fig. 4. Temperature and humidity throughout the plant are automatically controlled from a 23-ft. central panel in the boiler house. One of the plant's four boilers, each with a capacity of 100,000 lb. of steam hourly, is shown in the background.

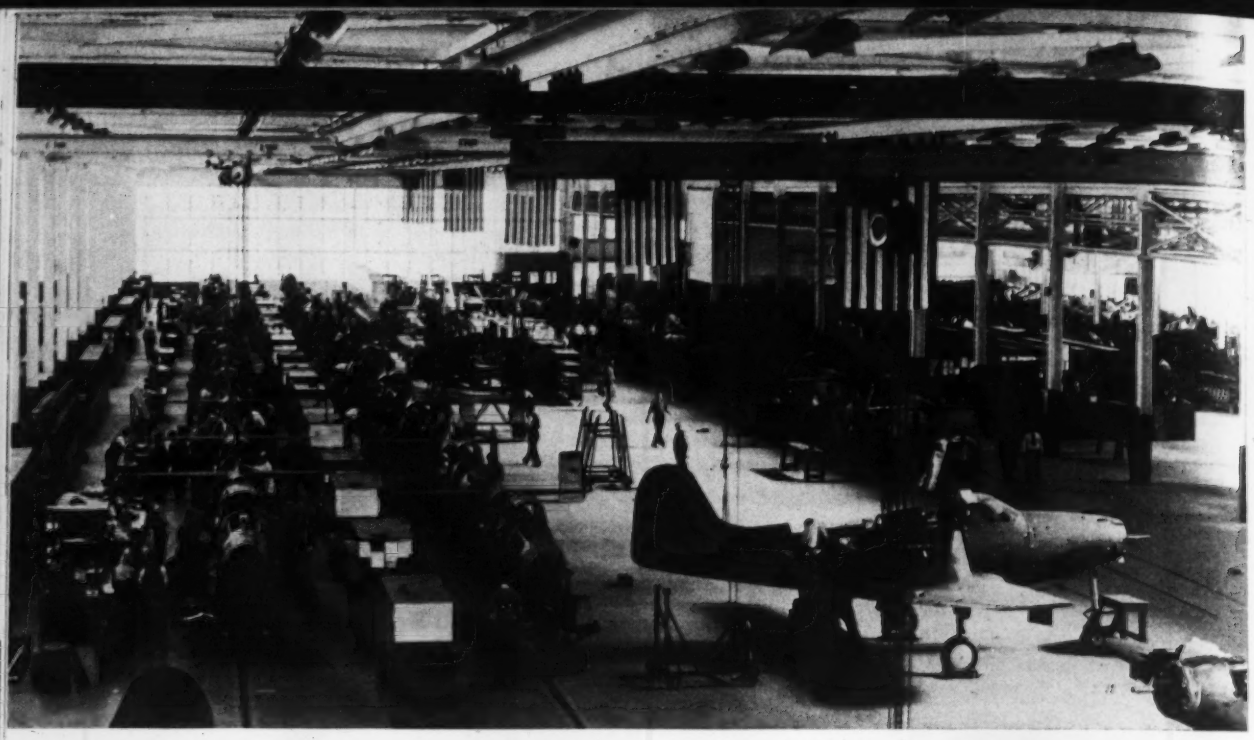


Fig. 1—Bell Airacobras are assembled on mechanized conveyor lines in this daylighted factory.

Flexible Plant for Plane Production

Contents in Brief—*Simplicity of structure is coupled with flexibility in layout to meet changing needs in airplane production in a war factory. Provision for adding mezzanines, plenty of natural light and ventilation and a conveyor for airplane assembly characterize the plant. An adjacent office building features a shadowless daylight drafting room with direct sun-rays controlled by special screens.*

THE FABRICATION and assembly building and an adjacent office for Bell Aircraft Corp. are the outstanding structures of a plant designed for flexibility, to make it possible to shift the facilities quickly to any type of warplane manufacture. The assembly end can handle either small or large wing spread planes by using parallel conveyor lines singly or in multiples; mezzanines can be added in many parts of the plant; and the structural steel building framing will carry much heavier cranes or overhead loads than are now supported on it. The one-story structure provides for material to enter at one end of the building, follow a conveyorized production line through the plant and be flown from the other end as a fighting plane.

Buff-colored face-brick, contrasting red brick and glass block have been used on the exterior in an unusual and pleasing architectural treatment. On the flying field side, buff-colored enameled sheets are used above the four double-section, 50-ft. wide doors that furnish a clear opening 195-ft. wide by 30 ft. high for passage of large or small-sized aircraft.

Manufacturing building

The building in which the manufacturing and assembly are carried on is a one-story, steel-frame structure with a basement under one third of the area and mezzanine floors over another third of the floor space. At the receiving end where sub-assembly and lofting (fabrication of small parts) is done, bays are 50x25 ft. As pieces are prepared, they are placed in parts bins or sub-assembly stock cribs that are moved on their own casters to the proper place on the production line. Then as assembly containers and units become larger, wider bays are required so that the 50-ft. spans give way to 100-ft., then to 200-ft. widths as the final assembly area is reached.

The building is founded on a good clay and shale sub-soil. Where no basement is provided, the floor of the building is a 5-in. reinforced-concrete slab laid on the earth. All floors are finished with a metallic hardener. The columns of the structural frame are wide-flanged, rolled sections throughout the building. The roof trusses over the 50-ft. spans vary in depth from 5 ft. at one end to 6½ ft. at the center (exclusive of a built-in monitor) to accommodate the slope of the roof for drainage. Purlins, parallel to the centerline of the building are 10-in., 21-lb. beams spanning 20 ft. and supporting sub-purlins of light rails. The rails are spaced about 2 ft. 8 in. c. to c. and vary from an 8-lb. bulb tee to 20-lb. special rail to support the roof covering over spans between purlins that vary from 6½ ft. to 13½ ft.

A 1-in. thick insulating board is laid on the rail flanges of the sub-purlins. This covering not only serves as an insulating and acoustic board, but also acts as a form for

the 2-in. gypsum fill, which is used in the proportion of 12½ lb. of fiber to 87½ lb. of stucco.

In the section of the building where 50-ft. spans are used a vertical clearance of 20 ft. is provided. Where the spans are 100 and 200 ft., vertical clearance is increased to 30 ft. Trusses for the 100-ft. spans are 7 ft. deep at the columns and 11 ft. at the center, while those for the 200-ft. spans are the same depth at the ends but rise to 23½ ft. at the center.

Space increased by mezzanine

In several of the 50-ft. bays a mezzanine floor is used, supported at the center of the bay to reduce the span to 25 ft. Clearance of 9 ft. under the mezzanine and 8 ft. 3 in. above it are provided. All the mezzanines are designed to be removable, and the bays throughout the building are prepared to permit addition of a mezzanine floor to facilitate rapid change in the manufacturing process. The columns are all punched for addition of members at the mezzanine floor height, and footings are in place in many positions to provide support for added columns.

Steel framing for the mezzanine is 27-in., 91-lb. transverse beams spanning 25 ft. between the columns and carrying longitudinal 18-in., 47-lb. floor beams at 8 ft. 2½ in. centers. The floor is a 4-in. concrete slab, with a plastic tile surface and designed to carry a live load of 125 lb. per sq.ft.

Plenty of glass

Corrugated wire glass, laid to the slope of the roof, is used to admit light to the building in the section where the long-span trusses are necessary. Where 50-ft. wide bays are employed natural light is admitted through the sides of 20-ft. wide monitors. There is an 8 ft. 8 in. high strip of glass in each side of each monitor, more than half of which is movable to assist in ventilation. On the south and west sides of the building a blue shade of ¼ in. thick wire-mesh hammered glass is installed, which prevents much of the heat of the sun, as well as direct rays, from entering the structure. The east and north exposures of the building are equipped with colorless, wire-mesh hammered glass.

About one-third of the building area has a basement underneath. This accommodates two cafeterias with a seating capacity of 2,000 persons and a modern kitchen. The basement also has employee lockers, wash and toilet rooms, thus saving valuable daylight and mezzanine space for manufacturing uses. Many of the utilities are placed in the basement because they can be cheaply housed and protected there. In the basement, concrete columns (20 and 22 in. diameter) of the "umbrella" type, on a 25x20 ft. spacing carry a concrete floor slab and support the structural steel of the building at the first floor level. In some areas the combined basement-roof and factory-floor is a 10½-in. thick reinforced-concrete slab designed for a 200-lb. per sq.ft. live load while in other areas a 13-in. thick slab is planned for a 400-lb. live load.

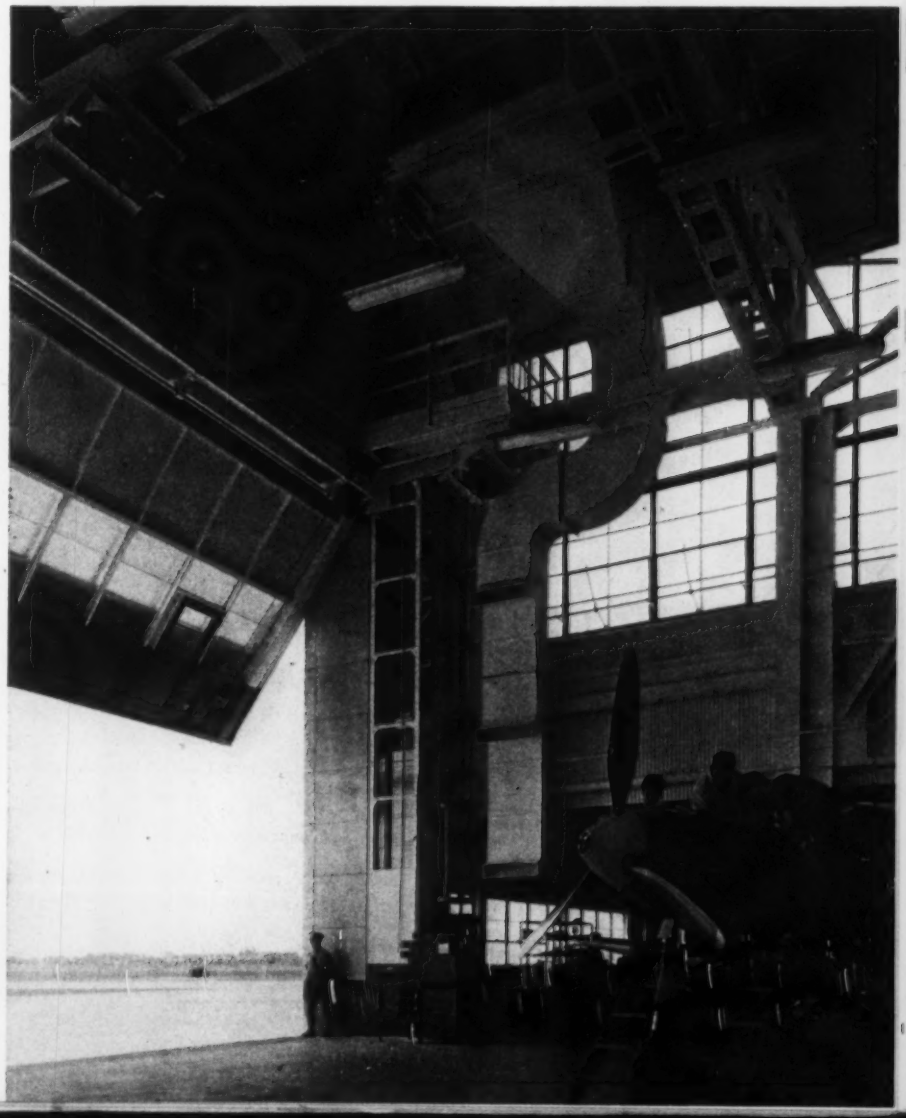
An employee entrance is provided at only one point in the plant. This leads directly from the parking area and bus discharge points, past identification gates, to the basement and locker rooms. An underground passageway continues under most of the plant to give workers access to their stations without passing through other departments.

Conveyor line

Drag chain conveyors in the floor are an important part of the manufacturing process and those installed here were among the first used for airplane building. Three parallel conveyors are installed in a 100-ft. wide bay and continue through the section where bays are 200-ft. wide.

Fuselage sections are assembled on a specially designed dolly that moves up to the drag chain conveyor and is hooked into it for movement along the entire assembly line. Each of the several completed sub-assemblies reach the assembly line on a dolly or frame at the point where it is to be installed. On the Airacobra production there are 14 stations along the

Fig. 2—The heating system includes special blower units to form a curtain of warm air across the open door areas. Doors are in double sections 50-ft. wide. The lower half pulls up then both sections swing out to provide a clear opening 30 ft. high.



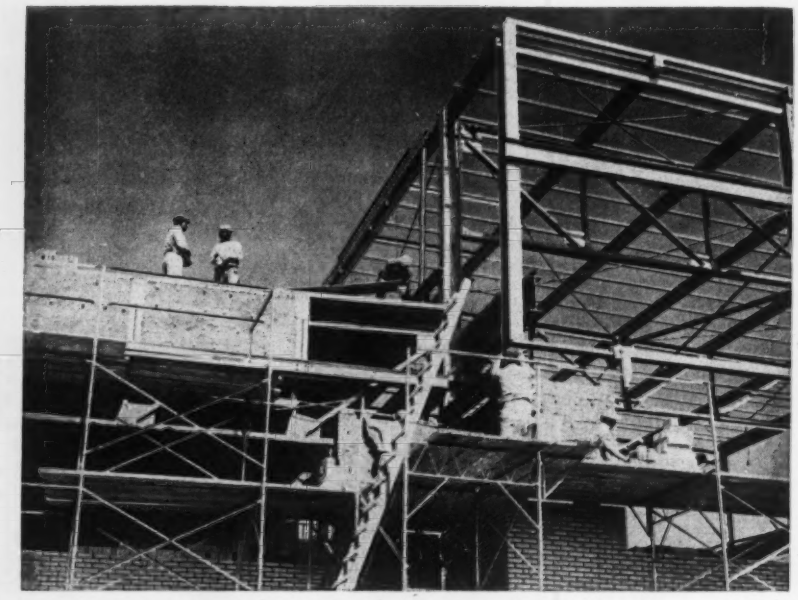


Fig. 3—Brick walls of the cavity type are used for the exterior of the office building to improve the insulation characteristics. Movable pipe frames provide safe work platforms for the construction.

final assembly line where major parts of the plane are installed or attached to produce the fighter.

A network of under-floor service ducts carries electric power facilities and compressed air to outlet boxes around the plant. These are spaced on 25-ft. centers throughout the building and 15 ft. apart along the final assembly line. Additional outlets are provided on the columns and at many overhead points.

The plant area is heated by unit blowers of the propeller type with steam supplied from an outside plant at a pressure of 85 psi. at the heaters. The basement of the structure is heated in winter and partially air conditioned throughout the year by a blower system operating through circulating ducts. Both pressure and exhaust fans are used in this system.

Office building

A separate building adjacent to the plant will accommodate executive offices and a drafting room. Exterior treatment is similar to the factory but much more glass block is used. Part of the structure is one story high with a promenade roof as an observation deck. A glassed-in tower, above all the surrounding buildings, gives an unobstructed observation point where plane test performances may be watched regardless of the weather.

The entire building is air conditioned and is heated from radiators concealed under the windows. Cost of air conditioning has been cut by use of good insulation throughout. Three course brick walls, insulation and plaster interiors provide a building with a low heat transmission. The glass block used has a course of insulating fiber through its center.

The floors of the office building, except where on the ground, are 4-in. thick concrete on metal lath laid on steel bar-joists. An asphalt-tile $\frac{3}{16}$-in. thick is used as a wearing surface.

The drafting room has all of the light it is possible to get through continuous bands of plate glass windows on two sides, glass block on a third side and a high monitor on the center line of the building whose walls are also of glass block. The walls and ceiling of the drafting room are white to provide even diffusion of the light throughout the room.

While the drafting room is air conditioned, special provision for additional heating has been made under continuous runs of sash and glass block in the side wall and monitors. Convector radiators, located behind grilles under windows, and steam lines extending through the sills, provide heat and prevent condensation on both plate glass and glass block at all levels.

Screens and shades combined

Screens for the south and west windows are a patented metal arrangement with horizontal slats about $\frac{1}{4}$-in. wide and $\frac{1}{2}$-in. apart in place of the conventional wire. The slats are turned to an angle preventing the passage of the sunlight, much as a venetian blind except that the angle is not adjustable. It is claimed that direct rays will not pass the screen until the sun is within 30 deg. of horizontal, thus preventing bright light from affecting workers near the windows.

The incoming light is restricted very little and vision through the screen is almost as good as for an ordinary screen. The screens are arranged so that they can be moved along an outside track to permit window cleaning. They are said to save 10 to 13 percent in installation cost over screens and blinds and about the same percentage of air conditioning operation cost.

Artificial lighting in the office is provided by four-tube fluorescent fixtures installed at ceiling height to provide 50 ft.-candles on the drafting boards.

A cafeteria on the first floor accommodates 400 but the table area can be converted to a small assembly or recreation room. Use of a quarry-tile floor in this section makes the room adaptable to any use and yet permits it to be kept clean. A motion picture projection booth at one end of the cafeteria also has openings into a smaller room that is to be used as a permanent projection room. The small room is to be used for showing of orientation movies to new employees and for technical study of action pictures of planes and the manufacturing processes.

The project was laid out, designed and constructed by The Austin Co., Cleveland and included, in addition to the aforementioned structures, a production hangar, an experimental hangar with 200-ft. clear span, an employment building, shipping building, a dope storage building, general storage warehouse, garage, boiler house, firing range, large fire protection reservoir and spray pond, pump house, switch house and sub-station, and a number of guard houses.

Lawrence E. Cooney was project manager and C. F. Appleton, project superintendent in charge of construction. The design was handled in the Cleveland office.

The plant was built for the Bell Aircraft Corp., acting for and on behalf of the Defense Plant Corp.

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CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

DIRECTIONAL AND PEDESTRIAN ISLANDS, WASHINGTON, D. C.

OWNER: Department of Highways, District of Columbia, Washington, D. C.

PROJECT: Construction of directional and pedestrian islands for channelization of traffic, including car loading islands, the reconstruction and changes in layout of roadways and curb lines, or alternates; setting or resetting of curbing; construction of gutters; repairs to sidewalks and other pavements disturbed by said work; repair of existing pavement; and other incidental and miscellaneous work necessary for completion of project. Islands are to be constructed on asphaltic and concrete pavements, and buttons are to be placed at nose end of islands. Also involves cleaning of the pavement areas in the various locations throughout the District upon which the islands are to be placed.

CONDITIONS: Contractor to furnish all materials except straight and circular 8x12-in. stone curbing which is to be furnished by the District, and the mushroom buttons which are to be furnished and hauled to the site of the work by the Capital Transit Co. Time for completion: December 31, 1942. Highway and rail transportation facilities available. Wage rates are: skilled labor, $1.25 to $1.50; intermediate grade, 80c. to $1.00; and unskilled, 75c.

BIDS: Three bids were received August 21, 1942, ranging from the contract low of $39,498 to $41,861. Awarded September 2, 1942.

LIST OF BIDDERS:

1. Donaldson Paving Co., Inc., Washington, D. C. (contract) $39,498
2. Wilmoth Paving Co., Washington, D. C. 40,576
3. McGuire & Rolfe, Inc., Washington, D. C. 41,861

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Earth, or ordinary excavation	150 c. y.	$0.90	$1.50	$1.00
2. Borrow excavation	25 c. y.	.90	1.50	1.00
3. Excav. existing hard-surf. pavmt. (bitum, pavmt. complete incl. conc. base)	50 c. y.	2.00	3.00	2.00
4. Excav. exist. hard-surf. pavmt. (asph. surf. and binder from conc. base stripping)	450 c. y.	2.75	3.00	3.00
5. Sidewalk excav	5 c. y.	.90	1.50	2.00
6. Remove roadway, bitum. tr. or water-bound macadam and old material	60 c. y.	.90	2.00	2.00
7. Dispose of surplus excavated matl.	12,200 c. y. ¼ mi.	.03	.03	.03
8. Plain cem. conc. base crse., 8-in	300 s. y.	3.30	2.60	3.50
9. Sheet asphalt pavement	300 s. y.	1.20	1.25	1.25
10. Binder mixture for sheet asph. pavmt.	20 ton	7.00	10.00	10.00
11. Surface mixture for sheet asph. pavmt.	50 ton	10.00	10.00	11.00
12. Bitum. surf. course, CM-A	50 ton	8.00	10.00	11.80
13. Cem. conc. sidewalks, 4-in	75 s. y.	2.45	2.20	2.60
14. Cement concrete curbing	300 l. f.	1.10	.90	1.30
15. Set 8x12-in. straight stone curbing	100 l. f.	.95	1.00	1.10
16. Set 8x12-in. stone curb, (circular)	125 l. f.	1.20	1.00	1.30
17. Reset 6x20-in. str. stone curbing	25 l. f.	.90	.90	1.00
18. Reset 8x12-in. str. stone curbing	25 l. f.	.90	1.00	.90
19. Reset circ. 8x12-in. stone curbing	50 l. f.	.90	1.00	1.00
20. Reset 8x8-in. str. stone curbing	250 l. f.	.90	1.00	.90
21. Reset 8x8-in. circ. stone curbing	25 l. f.	.90	1.00	1.00
22. Remove old stone curbing	150 l. f.	.40	.25	.25
23. New vitr. block gutter or alley entrances on 7-in. cement conc. base	50 s. y.	6.00	6.25	6.70
24. Adjust manhole frames and basin covers to grade	5 ea.	4.00	5.00	6.00
25. Adjust water valve casings to grade	5 ea.	6.00	5.00	7.00
26. Adj. public utilities' manhole fr. under 6 s. f. in area	2 ea.	1.00	5.00	1.00
27. As above, 6 to 16 s. f. in area	2 ea.	1.00	5.00	1.00
28. As above, over 16 s. f. in area	2 ea.	4.00	5.00	2.00
29. Cem. conc. for cem. conc. base course	20 c. y.	16.00	10.00	24.75
30. Cem. conc. for cem. conc. pavmt	10 c. y.	18.00	12.00	16.00
31. Cutting off vitr. block, cem. conc. rdway., alley, sidewalk pavmt., cem. conc. bases, asph. conc. pavmt., plant mix, to neat line	500 l. f.	.25	.25	.20
32. Removal of various types of old pavmt. when power shovel is impracticable	25 c. y.	3.00	3.50	4.00
33. Standard portland cement	25 bbl.	2.45	2.50	2.50
34. Calcium chloride	500 lb.	.03	.02	.02
35. Exp. joints for cem. conc. sidewalks	300 l. f.	.22	.25	.50
36. ¾-in. expan. joint for pavements, alleys	50 l. f.	.60	.50	.75
37. Asphaltic conc. base course	10 ton	8.00		
38. Surface heater treatment	800 s. y.	.40		
39. Cem. conc. for all types of islands	1,350 c. y.	23.67		
40. Mushroom type buttons in pavement	77 ea.	.60		
41. Conc. removed, 2-in. deep, in connection with cutting grooves for islands	20 s. y.	1.50		
42. Replace and repair cem. conc' sidewalks	150 s. y.	2.45		

HIGHWAY, NEW JERSEY

OWNER: New Jersey State Highway Dept., Trenton, N. J.

PROJECT: Construction of 1.199 miles of plain concrete pavement, Sections 3 and 4A, from Phipps Road to Mount Hope Mineral Railroad, Morris County, N. J. Roadway pavement width 24-ft., thickness 10-in. Includes necessary clearing, stripping, excavation, grading, drainage structures, pavement and bridge.

CONDITIONS: Rail and highway transportation facilities available. Work to be completed in 140 working days. Contractor to furnish all materials. Wage rates are: skilled labor, $1.75 to $2.25 per hr.; semi-skilled, $1.05 to $1.65; and common, $1.12½.

BIDS: Two bids were opened June 15, 1942, the contract low of $824,871, and $866,862.

LIST OF BIDDERS:

1. Franklin Contracting Co., Newark, N. J. (contract) $824,871
2. S. J. Groves & Son Co., Ridgefield Park, N. J. 866,862

Item	Quan.	Unit Prices (1)	(2)
1. Clearing site	L. S.	$11,000.00	$15,000.00
2. Stripping	11 ac.	100.00	300.00
3. Roadway excavation	108,594 c. y.	.40	.80
4. Roadway excavation (rock)	10,000 c. y.	4.00	2.15
5. Pavement excavation	2,831 s. y.	.50	.60
6. Wet excavation	26,909 c. y.	.40	.50
7. Borrow excavation	138,759 c. y.	.45	.60
8. Channel excavation	21,786 c y.	.80	.65
9. Channel excavation (rock)	4,006 c. y.	4.00	2.15
10. Rock excavation	500 c. y.	8.00	6.00
11. Earth excavation	100 c. y.	3.00	3.00
12. Subgrade	42,411 c. y.	.15	.25
13. Stone shoulders	11,137 c. y.	1.00	1.25
14. 4-in. topsoil	90,219 c. y.	.30	.25
15. 6-in. topsoil	909 c. y.	.30	.30
16. Conc. bag slope protection	128 c. y.	15.00	30.00
17. 4-in. macadam base course	14,751 s. y.	.80	.90
18. 6-in. macadam base course	1,091 s. y.	1.00	1.30
19. 5-in. pavement, "A"	154 s. y.	3.00	
20. 5-in. pavement, "T" (alternate)	154 s. y.		2.00
21. 8-in. concrete base course	1,057 s. y.	2.40	3.20
22. 3-in. modified penet. macadam	15,580 s. y.	.90	1.00
23. 2½-in. pavement, "A"	1,057 s. y.	1.40	
24. 2½-in. pavement, "T" (alternate)	1,057 s. y.		1.30
25. 1-in. pavement, "A"	15,734 s. y.	.60	
26. 1-in. pavement, "T" (alternate)	15,734 s. y.		.65
27. Resurfacing pavement	11 ton	20.00	20.00
28. 10-in. conc. pavement surface	40,578 s. y.	3.95	3.50
29. 18-in. bridge approach slabs	776 s. y.	8.00	6.00
30. 4-in. conc. joint sills	6,850 s. y.	2.50	2.00
31. Calcium chloride	7 ton	40.00	40.00
32. Federal project marker posts	2 ea.	25.00	25.00
33. Underdrain, type F	1,000 l. f.	1.20	1.00
34. 18-in. rein. concrete pipe	3,823 l. f.	2.40	2.70
35. 24-in. rein. concrete pipe	268 l. f.	3.00	4.50
36. 30-in. rein. concrete pipe	72 l. f.	5.00	7.20
37. 36-in. rein. concrete pipe	68 l. f.	7.50	8.90
38. 6-in vitr. clay pipe	40 l. f.	1.50	1.25
39. 18-in. cast iron pipe	20 l. f.	7.00	6.00
40. Inlets	75 ea.	125.00	150.00
41. Grouted rubble gutter	87 s. y.	3.00	2.00
42. 7x20-in. concrete curb	17,996 l. f.	1.25	1.30
43. 15x18-in. white conc. curb	395 l. f.	1.50	1.35
44. Headwalls	64 c. y.	30.00	35.00
45. Wooden guard fence	12,914 l. f.	1.25	1.90
46. Broken stone or screened gravel	34 c. y.	3.00	4.00
47. Wood barricade	158 l. f.	3.00	3.00
48. Stone ballast	57 ton	2.25	4.00
49. 12x12-in. concrete header	173 l. f.	1.25	1.50
50. 12x22-in. concrete header	135 l. f.	2.40	2.50
51. Ditch excavation	590 c. y.	2.00	1.00
52. 2½-in. asbestos	350 l. f.	2.00	.75
53. Foundation excavation	3,788 c. y.	12.40	6.00
54. Class B conc. in structures	1,896 c. y.	36.00	47.00
55. Class C conc. in structures	3,933 c. y.	28.90	27.50
56. Concrete balustrade	609 l. f.	7.00	8.00
57. Reinforcing steel in structures	428,755 lb.	.075	.09
58. Structural steel	5,865 lb.	.12	.22
59. Waterproofing	7,258 s. f.	.40	.40
60. Lighting units	4 ea.	75.00	66.00
61. Pull box, frame and cover	1 ea.	75.00	77.00
62. 2-in. conduit	310 l. f.	2.00	.80
63. Timber piles	4,460 l. f.	1.10	1.50
64. Remove Parker Road bridge	L. S.	2,500.00	1,700.00
65. Remove Mt. Hope — Mt. Pl. bridge	L. S.	1,750.00	1,100.00

Prevent Valve Failure

before it starts!

CHOKED TO DEATH
by accumulated deposits, because of improper installation, and lax servicing . . .

This valve never had a chance! It was installed in a downward line where the solids collected while the valve remained closed. The deposits choked off the flow of liquid and destroyed the seat.

A more favorable location of the valve in the line, or the use of a type better suited to the purpose, would have prevented the accumulation of solids. Or, if the line had been provided with a drain, if it had been flushed out at regular intervals – even in its faulty location, the valve could have been kept in service indefinitely.

All valve metals are precious today. Except for valves in the most essential wartime service, replacements are practically unobtainable. Careless destruction *must* be prevented, and it *can* be prevented, *before it starts.*

Select valves for new construction carefully, see that they are installed properly. Recommend regular, systematic inspection . . . replacement of worn parts in time to prevent valves from destroying themselves . . . thorough instruction of new maintenance workers.

Valve conservation, always good practice, is now a vital factor in maintaining the flow of arms and supplies to our fighting men. Help the plants you serve keep valves operating efficiently.

Jenkins Engineers are ready to furnish any information required for developing a practical program of valve care.

Army-Navy "E" Pennant, awarded to Jenkins Bros. for high achievement in the production of war equipment.

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For every industrial, engineering, marine and power plant service . . . in Bronze, Iron, Cast Steel and Corrosion-Resisting Alloys . . . 125 to 600 lbs. pressure.

Winning the Battle for water on land

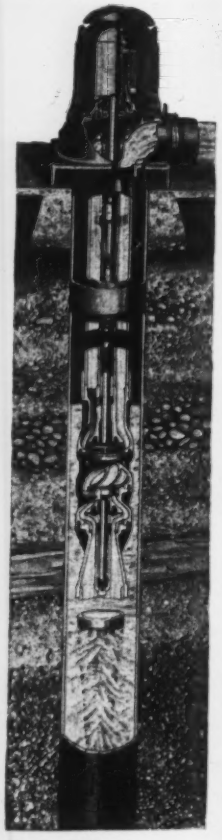
THE FORESIGHT OF PEERLESS resulted in the expenditures of thousands and thousands of dollars for increased facilities in preparation for meeting the present-day requirements of the Nation's war-time demands.

THE LEADERSHIP OF PEERLESS in engineering improvements provided longer-lasting, trouble-free pumping service during the life of the pump.

THE DEPENDABILITY OF PEERLESS over the long life of the pump gives years of extra service.

THE POPULARITY OF PEERLESS is proved by the fact that it's America's largest selling Pump in peace or war!

THE AVAILABILITY OF PEERLESS Pumps is nationwide. Peerless distributors are located in every State and every Allied country.



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NATIONWIDE SUPER SERVICE

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WATER OR OIL LUBRICATION
Peerless
TURBINE PUMPS

MEN AND JOBS

Harry C. Vansano, San Francisco civil engineer, has been appointed San Francisco Public Works Director to succeed the late Alvin D. Wilder. Vansano was director of works for the 1940 Golden Gate International Exposition and is a native of San Francisco.

Paul C. Laux, city chemist of Anderson, Ind., has been named as superintendent of the city's million dollar sewage disposal plant, succeeding **Frederick L. Ray,** who resigned recently.

George R. Prescott, resident engineer for the North Carolina State Highway Public Works Commission at Sylva, has resigned to join the U. S. Navy.

Philip T. Samuel, recently commissioned a lieutenant colonel in the Corps of Engineers, has been appointed executive officer of the Philadelphia Engineer District. Col. Samuel formerly occupied the post of head engineer for the Philadelphia district in charge of the marine division.

Col. T. W. Bean, formerly area engineer for the Corps of Engineers at Medford, Ore., has been transferred to the Walla Walla, Wash., area in the same position. He succeeds **Maj. Charles C. Phillips,** who was transferred to Corvallis, Ore.

C. F. Misenheimer has been appointed superintendent of streets at Brevard, N. C., to succeed **Philip Price.**

Maj. Carl Anderson, acting area engineer, Upper Columbia area, has been assigned to the district control section at Seattle, Wash.

William B. Stronach of Morganton, N. C., sanitarian with the Burke County health department, has been named district sanitarian for the North Carolina State Board of Health. He succeeds **W. A. Broadway, Jr.,** of Asheville, who recently entered military service.

W. H. Moore, of Akron, Ohio, has been appointed division engineer for Division 4, of the Ohio Department of Highways, succeeding **Capt. Homer E. Anderson,** of Alliance, who reported recently for active service in the army. **Harold L. Hubbell,** of Kent, was appointed assistant division engineer in charge of maintenance, succeeding Mr. Moore in that post.

Charles R. Furlong, for the past two years a member of the engineering staff of Stone & Webster, Boston, Mass., has enlisted in the Canadian army.

W. Loundes Daniel, formerly assistant professor of engineering of The Citadel, Charleston, S. C., has been promoted to the rank of lieutenant colonel on the staff of the Army Air Forces at Washington, D. C. Colonel Daniel entered active service in 1940 as a captain in the South Carolina National Guard.

John P. Jones, an engineer formerly engaged on work on the Central Valley project in California, has been assigned to the office staff of the Bureau of Reclamation in the Lower Rio Grande Valley, at McAllen, Texas. Mr. Jones will work under **Charles Seger,** construction and supervising engineer, on a gravity canal project in the Lower Rio Grande Valley that stretches 168 miles down the Rio Grande from Zapata to Brownsville, Texas.

William C. Olsen, Raleigh, N. C., civil engineer, has been retained as resident and supervising engineer on a $12,000,000 municipal water supply project being built by the city of Wilmington, N. C., at King's Bluff.

Earl E. Logan, formerly employed by the Bates & Rogers Construction Co. at Illiopolis, Ill., has been appointed building inspector for the city of Decatur.

M. E. Boriss, Jefferson County, Ala., sanitary engineer, has entered active service in the U. S. Army. **Robert Barton,** chief chemist of the department, will temporarily assume Mr. Boriss' duties.

Capt. Byron E. Doll has succeeded Lt. Col. T. W. Bean as area engineer for Camp White, Ore. Colonel Bean recently was transferred to Walla Walla, Wash.

Raymond W. Fisher has resigned as city engineer of Los Gatos, Calif., because of press of other business.

Capt. J. Wiley Finney, of Nashville, Tenn., former sanitary engineer for the Tennessee Health Department, has been promoted to the rank of major in the U. S. Army.

J. W. Mills, former construction engineer for the North Carolina State Highway and Public Works Commission at Raleigh, is now general superintendent for the F. D. Cline Co. of Raleigh.

B. M. Shimkin, 54, associate designing

Use Timken Bits—Enjoy Greater

AND HERE'S WHAT WE MEAN BY GREATER FLEXIBILITY . . . .

A driller starts a hole with a two foot steel equipped with a 3" bit forged integrally. After drilling a foot he strikes extremely hard rock—the bit begins to lose gauge rapidly, so rapidly that his following four foot steel with a 2⅞" integrally forged bit cannot enter the hole if he drills the maximum distance with his starter.

Unless he has an enormous stock of drill steel at the working face with many rods of identical length, the result will be a hole far short of the desired depth.

With the Timken Bit on the starter steel this need not happen for even if it began to lose gauge rapidly, merely screw on a new bit of the same gauge and complete the run. This procedure may be used with any rod in the set.

Conversely, if the going is easy and there is little or no gauge loss it is possible to obtain a constant gauge hole all the way down with a Timken Bit by removing it from short steels and putting it on the next longer size.

There is a lot more information about the advantages of greater flexibility than can be crowded on this page. Write us for it.

The advantages of Timken Bits are so outstanding that you need them for Victory drilling and cannot afford to be without them in post-war competition.

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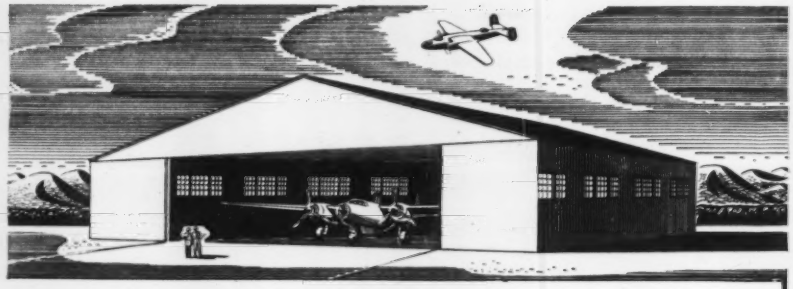

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WOOD STRUCTURES go up easily and fast, speeding construction that is vital to our war effort. Wood combines its own high insulating value with structural strength. Its use releases scarce materials for combat equipment.

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DECISIONS TO USE Wolmanized Lumber for these wartime structures are based on service records covering the past sixteen years. They prove that this vacuum-pressure impregnated wood is able to stand up on the tough jobs.

POSTWAR PLANNING wisely includes the use of Wolmanized Lumber as a barrier against decay and termite attack. We'll gladly send you data on where and how it is being successfully used. Write American Lumber & Treating Company, 1649 McCormick Building, Chicago, Illinois.

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WOLMANIZED LUMBER

engineer for the California [illegible] highway bridge department, has won an award in the nation-wide industrial study on arc welding promoted by the James F. Lincoln Arc Welding Foundation. Another Northern Californian to receive awards in the study is **Gilbert L. Yetter,** of the Bureau of Reclamation staff at Redding.

R. C. Stribling, who has been resident engineer for the Gulf Oil Corp. in the Mississippi Delta area of Louisiana for the past two years, has recently been transferred to the company's Houston, Texas, office.

C. L. McGinnis, Miami, Fla., construction engineer, has been commissioned a lieutenant commander in the U. S. Navy and has reported to Norfolk, Va., for duty.

Delmar Clark Bogart, formerly employed as an engineer on the Bonneville dam, has been promoted to captain in the Corps of Engineers.

A. B. Wills, senior administrative assistant of the Portland district engineer's office, recently retired from his post after 31 years of service.

Lt. Godfrey Engel, formerly a draftsman with the Denison Engineer District, was one of the Airmen who participated in a raid in August on Rouen, France. Lieutenant Engel, whose home is in Albany, Tex., enlisted in the Army Air Force a year ago.

C. P. Wyman, works manager of the Minas Basin Pulp & Power Co., Ltd., Hantsport, N. S., has resigned to accept appointment as administrative officer of the Royal Canadian Air Force at Lachine, Que.

Allen Hargrove, of Tuscaloosa, has been named executive secretary of the Alabama highway traffic advisory committee to the War Department, according to Highway Director **W. G. Pruett.**

Alfred Cheney, Jr. has been named resident engineer in charge of the construction of the Kinston-Lenoir County, N. C., airport.

Paul Weir for the past 11 years superintendent of filtration at Atlanta, Ga., has been appointed assistant general manager of the city's water department. He is the first engineer in the history of the department to hold this position, the appointment, climaxing a 14 year career in the city's employ.

Robert C. Mills has been appointed Pacific County engineer at South Bend, Wash.

MEETINGS

National Safety Council, 31st National Safety Congress and Exposition. Chicago. Hotel Sherman, La Salle and the Morrison. Convention headquarters in the Sherman, Oct. 27-29.

American Public Health Association, St. Louis, Mo., Oct. 27-30.

Institute of Traffic Engineering, Sherman Hotel, Chicago, Ill., Oct. 25-26.

National Society of Professional Engineers, 8th annual meeting, Claypool Hotel, Indianapolis, Oct. 31.

Industrial Hygiene Foundation, 7th annual meeting, Mellon Institute, Pittsburgh, Pa., Nov. 10-11.

Highway Research Board, 22nd annual meeting, Hotel Statler, St. Louis, Mo., Dec. 2-4.

American Association of State Highway Officials, annual meeting, Hotel Statler, St. Louis, Mo., Dec. 7-9.

Regional and Local Meetings

Engineers' Society of Western Pennsylvania, Third Annual Water Conference, Wm. Penn Hotel, Pittsburgh, Pa., Nov. 9-10.

Texas Section, American Society of Civil Engineers, fall meeting, Rice Hotel, Houston, Texas, Nov. 5-6.

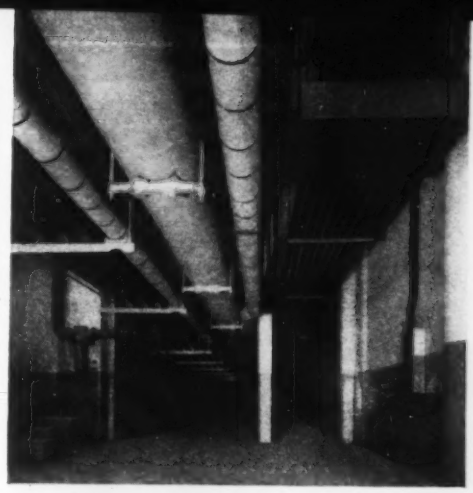
American Waterworks Association, California Section, 23rd annual convention (War Conference), Oakland Hotel, Oakland, Calif., Oct. 28-31.

Illinois Water-Plant Operators' Conference, Leland Hotel, Springfield, Ill., Nov. 4-5.

Elections and Activities

H. M. Pierce, city engineer of Huron, S. D., was elected president of the South Dakota Water and Sewage Works Conference at the organization's eighth annual meeting at Huron recently. Tom Newell, of Brookings, was elected vice president, and E. R. Mathews, of Pierre, was elected secretary-treasurer.

Asher Case, former Alliance, Ohio, resident, who recently returned from the Pacific war theater, was a speaker at the regular meeting of the Canton Regional Society of Professional Engi-



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3 PIPE AND TUBE FITTINGS—Steel, cast iron, malleable iron, brass, aluminum . . . screwed, flanged, socket, flared tube and welding.

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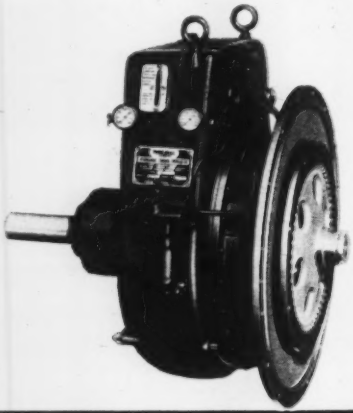
Some crane operators claim that with a Twin Disc Hydraulic Torque Converter they could set a heavy load like this on an egg without breaking it. We've never seen it tried but we have seen I-beams weighing several tons held in the air and then inched into position with just as delicate a touch.

We know that the Twin Disc Torque Converter will multiply your engine's torque at low speeds, allow it to lift and maneuver a load of three to five times its normal torque capacity without shock or jerk—with no chance of stalling the engine.



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neers and Surveyors. Mr. C[illegible] resided in the Orient for many year[illegible] and was held a prisoner by the Jap[illegible] after their occupation of Thailand.

MEMBERS of the Engineering Society of York, Pa., opened their fall program with a business meeting and social at the society's building. At the meeting, it was announced that the board of directors had purchased a $1,000 war bond for the society, and has donated funds to the Martin Memorial Library to purchase books pertaining to engineering work.

THE ATLANTIC DEEPER WATERWAYS ASSOCIATION opened its 35th annual two-day convention at the Hotel Bellevue-Stratford, Philadelphia, Pa., Oct. 22, to discuss construction and completion of an improved waterway along the Atlantic seaboard from New England to Florida.

THE 22ND ANNUAL JOINT CONFERENCE of the North Carolina section of the American Water Works Association and the North Carolina Sewage Works Association will be held Nov. 2-4 at the Washington Duke Hotel, Durham, N. C. The technical program is said to have been streamlined to a short meeting in line with the government's request that week-end travel be eliminated. The conference will devote itself almost exclusively to conditions arising out of the war effort as related to the water and sewage works personnel. Speakers will include Arthur E. Gorman, chief, water supply section, War Production Board; Maj. D. W. Evans, regional sanitary engineer, Office of Civilian Defense, Atlanta, Ga., and Dr. Abel Wolman, president of the American Water Works Association.

THE FIRST FALL MEETING of the Cleveland section of the American Society of Civil Engineers was held recently. Principal speaker was Milton S. Fox, head of the civil engineering department of the Case School of Applied Science.

HAROLD M. BIRTLEY of Tallahassee, Fla. has resigned as secretary of the Florida Section of the American Road Builders Association, to take up private employment.

A. O. WOLFF, district engineer for the Canadian Pacific Railway at St. John, N. B. has been appointed councillor to represent the St. John branch of the Engineering Institute of Canada until the next annual election, replacing Lt. Col. H. F. Morrisey who died recently.

MEMBERS of the Chattanooga, Tenn., Engineers Club recently heard a talk by Max H. Kimbrough, state fire mar-

shal, on means of preventing disastrous fires in industrial buildings and in homes and parks.

W. H. STUEVE, power plant consultant for the Oklahoma Gas & Electric Co., recently was elected president of the Oklahoma City, Okla., Engineers Club, succeeding Ralph Lee, Oklahoma City engineer. Other new officers elected were Ralph Randall, first vice president; J. W. Rogers, second vice president; and Charles Newberry, secretary.

THE NINTH ANNUAL conference of the Virginia section of the American Water Works Association will be held Thursday and Friday, November 5-6, at the Hotel Jefferson, Richmond, Va. Speakers will include Gordon E. McCallum, assistant chief sanitary engineer, Office of Civilian Defense; E. F. Dugger, general manager of the water commission of Newport News, Va.; Charles E. Moore, manager of the Roanoke, Va. water department; Marsden C. Smith, chief engineer of the department of public works, Richmond, Va.; Harry F. Jordan, secretary of the American Water Works Association and Richard Messer, director of sanitary engineering, Virginia state health department.

THE SOCIETY OF AMERICAN MILITARY ENGINEERS has established a post in Atlanta, Ga., with 150 members. Maj. W. I. Kenerson has been elected president; F. C. Houpt, vice president, and Burton J. Bell, secretary.

THE Associated General Contractors of Missouri have moved their offices into the Hotel Governor, Jefferson City, Mo.

THE 11TH ANNUAL school for water and sewage superintendents and operators was held at Georgia Institute of Technology, Atlanta, Ga., Oct. 15-16, under the auspices of the Georgia Water and Sewage Association, the school and the state department of health.

THE 31ST ANNUAL convention of the Southwest Section of the American Water Works Association was held recently at Little Rock, Ark., with waterworks executives and engineers from Arkansas, Louisiana, Oklahoma and Texas in attendance. Speakers included Davis M. DeBard, vice president of Stone & Webster Corp., New York City.

WESTERN PENNSYLVANIA SECTION, A.W.W.A., and the Western Pennsylvania Water Works Operators Association held a joint meeting recently at the Roosevelt Hotel, in Pittsburgh, to discuss war problems in waterworks. M. G. Mansfield, vice president of Morris Knowles, Inc., Pittsburgh, was in charge of the meeting.

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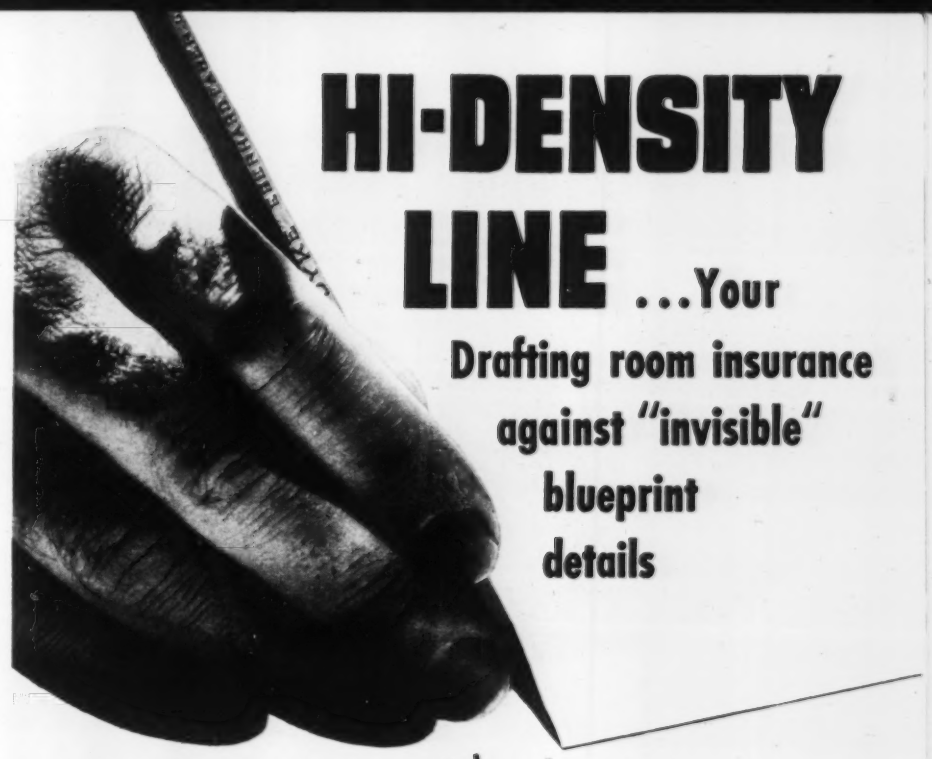

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REZNOR Gas Fired Unit Heaters answer the heating demands of Army and Navy establishments as well as countless industrial factories operating on war contracts. Furthermore, new construction and remodeling call for Reznor's 5 outstanding installation economies: (1) the use of 89% less vital material, (2) the need of fewer men, (3) the reduction of construction time, (4) lower over-all cost, and (5) the complete saving of floor space. Reznor Units are manufactured in a full range of sizes. Write today for complete data.

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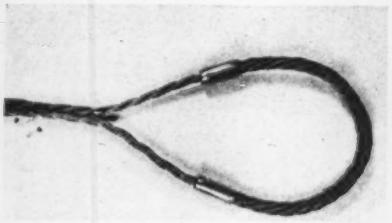


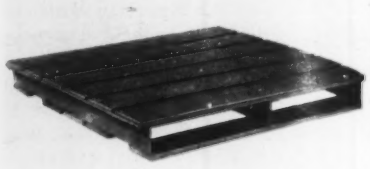
loads more easily. It was developed specifically for lifting light and medium loads where the legs choke the load or the sling comes in direct contact with the load being lifted. "Flatweave" slings have a flat bearing surface which allows an even pressure on each of the six ropes which comprise the sling, thereby prolonging its useful life. The body of the sling is made up of six separate ropes; two pairs each laid in opposite directions. These are united into a finished sling unit by two single tie ropes which alternately pass back and forth around one pair and then the other in a spiral figure 8. This method of construction eliminates the possibility of any scissors or shearing action between the various ropes.—*John A. Roebling's Sons Company, Trenton, N. J.*

Water Detector Lock

Photoswitch Incorporated has announced an electronic water detector lock type P15NH to indicate water seepage in gasoline storage tanks. This type is supplied with probe fitting type H31. The probe fitting is mounted in a standard pipe fitting on the top surface of the tank, the probe rod projecting down through the tank to the level at which water seepage is to be detected—usually three inches from the bottom of the tank. The water detector is located at any point remote from the tank and wired to the probe. While the probe rod is entirely immersed in gasoline and as long as water seepage has not reached the probe, no signal is given. When water seepage rises to contact the probe tip, an electrical circuit is completed through the water itself, and the water detector lock operates, turning off pumping equipment and actuating an alarm circuit.—*Photoswitch Incorporated, 21 Chestnut Street, Cambridge, Mass.*

Pallet

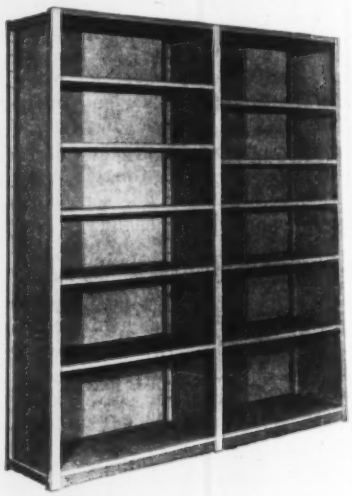
The Union Metal Manufacturing Company of Canton, Ohio, maker of steel skids, boxes, pallets, and other material-handling units, has announced a new product, specifically designed to aid the



nation's war effort. This new product is a sturdy pallet, consisting of top and bottom wood slats, reinforced with steel at the ends and in the center. Bolted construction permits easy replacement of the wood slats, while the steel ends protect the pallet from damage by power fork trucks. Vital metal is thus conserved without sacrificing strength and all-around usefulness.—*Union Metal Manufacturing Company, Canton, Ohio.*

Shelving in Wood

Quickly adjustable shelving, essential for saving floor space in wartime indus-



tries is now offered in wood by Lyon Metal Products, Incorporated. Lyon wood shelving is made in open and closed types. Sections are 36 in. wide and 84 and 96 in. high, and may be had in 12, 18 or 24-in. depths. Top, base, shelves, braces, arms and uprights are made of solid hard wood. Side panels, back pan-

★ ★ ★ War Paint for the War of Words ★ ★ ★

THESE are days to test a nation's metal—metal that must stand up in ships and bridges, gas tanks and pipe lines, factories and countless other vital structures.

Take, for example, radio towers. On guard while the Voice of Democracy speaks is the Nation's No. 1 undercover agent—Red Lead. For protecting metal is an undercover job at which Dutch Boy Red Lead is unexcelled.

Its unassailable position as a rust preventive is a result of intensive research, coupled with years of practical experience in the field.

Available in three forms—paste, liquid, and quick-drying—Dutch Boy is made with highly oxidized red lead having a true red lead (Pb_3O_4) content of more than 97% and characterized by extremely fine particle size. This assures a smooth, durable, protective film—that hugs tight, and is highly resistant to dampness, smoke, sulphurous gases, salt water and other causes of corrosion.

The quick-drying form of Dutch Boy Red Lead was especially developed for situations where allowable drying time is short. There are two types. One dries for recoating in 4 to 6 hours and the other for recoating the next day.

In practically every American industry Dutch Boy Red Lead is helping to protect the home front and strengthen the Victory drive.

★ ★ ★

NATIONAL LEAD COMPANY: New York, Buffalo, Chicago, Cincinnati, Cleveland, St. Louis, San Francisco, Boston (National-Boston Lead Co.), Pittsburgh (National Lead & Oil Co. of Penna.), Philadelphia (John T. Lewis & Bros. Co.)

DUTCH BOY RED LEAD

One Man Does the Work of Five

—and Gets Better, Stronger Concrete

"THROW YOUR SCRAP INTO THE FIGHT"

Mall TRADE MARK

3 H. P. ELECTRIC VIBRATOR

● Here's the one man MALL Electric Geared Head Vibrator that is saving man hours, time and materials on War Construction jobs.

This big capacity unit is recommended for placing large masses of low-water-cement-ratio concrete for dams, locks, piers and other heavy construction. Operates 2⅜" diameter concrete vibrating element. It is easily carried by one man anywhere on the job and provides super-power for every application. Other gasoline-powered, electric and pneumatic units 1½ H.P. to 3 H.P. are available for War Construction.

Write, wire or phone for full details.

★ ★ Manufacturers of Portable Electric Saws, Drills and hundreds of other portable power tools and attachments

MALL TOOL COMPANY

7730 SOUTH CHICAGO AVE. CHICAGO, ILLINOIS

Offices and Distributors in Principal Cities

WRITE TODAY FOR THIS 24 PAGE BUCKET CATALOG

Just off the press is this two-color, twenty-four-page catalog packed with the facts you'll want to know about buckets. Which bucket is best suited to the job and what each type (rope-reeve, power-wheel, special-purpose, open-type grab and link-type) will do is clearly explained by word, chart and photograph. If you haven't received your copy, write for it today.

THROW YOUR SCRAP INTO THE FIGHT!

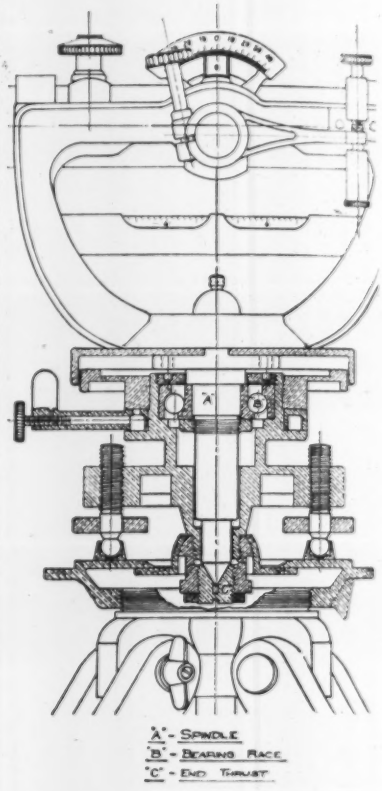
INDUSTRIAL BROWNHOIST

BAY CITY, MICH. • DISTRICT OFFICES: NEW YORK, PHILADELPHIA, PITTSBURGH, CLEVELAND, CHICAGO

els on closed type are ¼ in. [illegible]. Finished with a green tinted pre[illegible]ative coating that reduces moisture abs[illegible]tion, the units are easy to set up.—*Lyon Metal Products, Incorporated, 3049 Clark Street, Aurora, Ill.*

Universal Level Transit

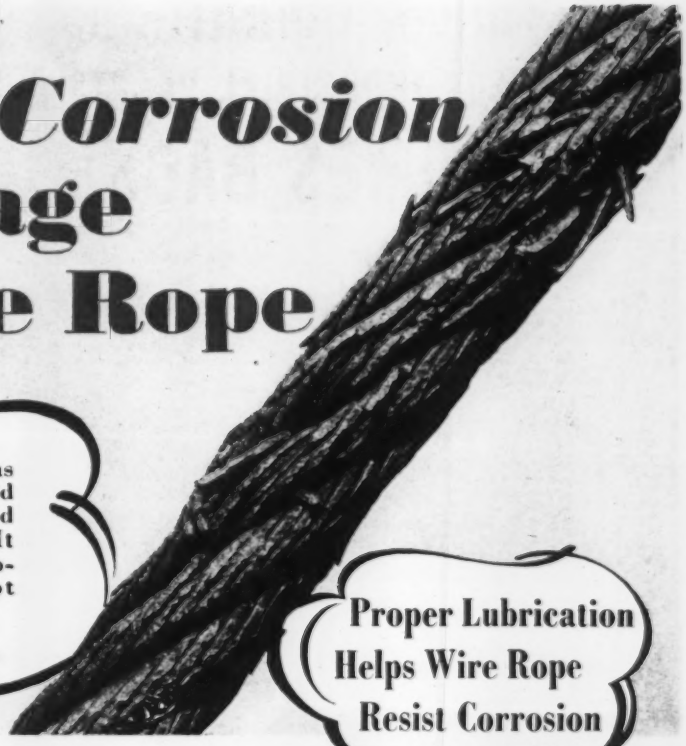
Several important features have been added to the universal level transit which has been a standard instrument among contractors and engineers throughout the country for many years. The most important patented feature is the ball bearing race shown in detail in the illustrations. Spindle A is supported by bearing B and end thrust adjustment cone C. This patented feature insures perfect adjustment under the most severe conditions, and will not drag or tighten in sub-zero temperature. The instrument is equipped with the same high power telescope as in the higher priced engineers' transits. It is also equipped with a clamp and a tangent screw to both the horizontal and vertical circle. A compass can also be supplied if desired.—*David White Company, 315 West Court Street, Milwaukee, Wis.*



Seal Coat

Carbo Seal Coat, a new product being manufactured by the Carbozite Corpo-

Don't Let *Corrosion* Sabotage Your Wire Rope



The illustration at the right was made from an unretouched photograph of a wire rope used for hoisting in a coal mine. It fell an early victim to corrosion because it was not kept properly lubricated.

Proper Lubrication Helps Wire Rope Resist Corrosion

CORROSION is an enemy saboteur that is constantly trying to destroy your wire rope. Unless combatted by proper lubrication, normal rope life is greatly shortened and a serious hazard to safety created.

Wire Rope is an intricate machine with many "bearings". If it is to give the full service of which it is actually capable, these points of contact—both externally and internally—must be kept correctly and adequately lubricated at all times.

The right kind of lubricant to use and the frequency with which it should be applied depends upon the conditions under which your rope is operating. When in doubt, we suggest you consult with an experienced wire rope manufacturer.

Now that steel is so urgently needed for so many implements of war, the more "work hours" you can get out of your wire ropes, the more steel you save for other vital purposes. So in all earnestness we repeat—*Don't let Corrosion sabotage your wire rope.*

*** *Important* ***

An idle wire rope is more vulnerable to corrosion than one in use, so be sure to give your ropes the protection of a good lubricant when they are not in service.

A. LESCHEN & SONS ROPE CO.

WIRE ROPE MAKERS — ESTABLISHED 1857

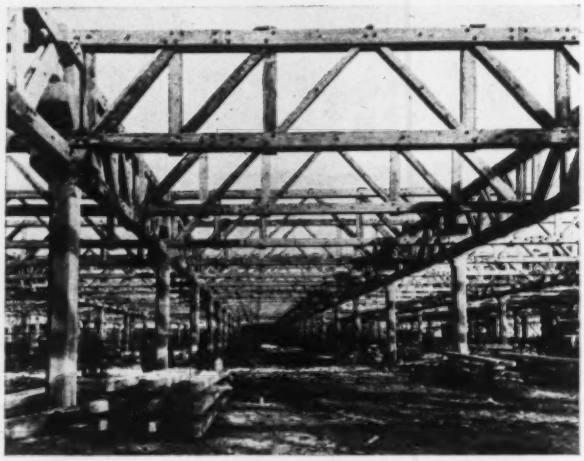
5909 KENNERLY AVENUE — ST. LOUIS, MISSOURI, U. S. A.

NEW YORK . . . 90 West Street
CHICAGO . . 810 W. Washington Blvd.
DENVER . . . 1554 Wazee Street

HERCULES RED STRAND WIRE ROPE

SAN FRANCISCO . . 520 Fourth Street
PORTLAND . . 914 N. W. 14th Avenue
SEATTLE . . 3410 First Avenue South

Timber Construction
FOR INDUSTRIAL PLANTS
COMES BACK!

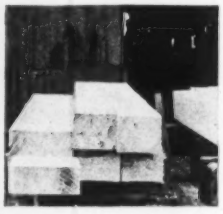


Teco Connector-built trusses in a war plant, Somewhere, South

WITH steel production now absorbed in the manufacture of vital fighting materiel, engineers and builders have switched to lumber and timbers for factory, plant and other heavy construction.

They are on solid ground in doing so, because heavy timber construction has proved dependable and lasting in textile mills, factories, shipyards, warehouses, canneries, etc., over life-spans of 75 years and more.

Timber construction is flexible, rapid, adapted to time-saving prefabrication. Over-all building costs are in line. With Teco Ring Connectors, load bearings and joints compare in strength with those of steel. Under modern chemical treatments, timbers are effectively resistant to deterioration and fire. Even untreated timbers are slow burning, do not buckle.



Today's timber construction projects include ordnance plants, munitions factories, recreation centers, hangars, theatres, warehouses, machine shops, etc., with countless more on drafting boards. *Heavy timber construction has come back!*

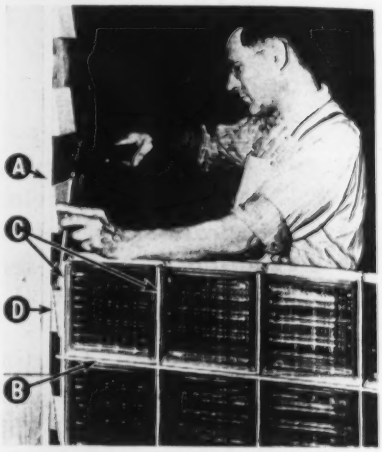
Arkansas Soft Pine is supplying a substantial volume of lumber and timbers to these war projects. This species qualifies for all structural requirements under Federal Specifications MM-L-751b and offers a sustained source of standardized heavy construction material and framing lumber. *For technical data, specifications and complete information, all without charge, address:*

ARKANSAS SOFT PINE BUREAU
1024 BOYLE BUILDING
LITTLE ROCK, ARKANSAS

ration, and designed for use over the sealing of asphalt or bituminous coatings used for water proofing and which in many cases will not permit the application of light colored coatings without a bleeding through by the asphalt. Carbo Seal seals off the asphalt or bituminous coating, preventing this bleeding. After the Carbo Seal Coat dries, the finish coatings can then be applied with no trouble. Designed to replace aluminum paint, now virtually unobtainable, the new product is an emulsion coat.—*The Carbozite Corporation, First National Bank Building, Pittsburgh, Pa.*

Glass Block Walls

New walls constructed of non-critical materials are promised by a demountable partition developed by the Insulux Division of the Owens-Illinois Glass Company. Quick to erect, this new system offers many possibilities in interior office, store and home layout. The interior partitions are set up quickly and simply. A wood frame is first erected on walls adjoining the new partition. The glass block partition is then set up, with prefabri-



cated wood moldings holding the blocks in position. These wood moldings are of two kinds: horizontal and vertical. The raised ridges on the faces fit snugly into the flutings on the edge of the glass blocks. Notched ends of the vertical moldings lock over the ridges on the horizontal molding. The wood strips may be painted or stained to match trim or furniture. A third prefabricated wood member consists of paired wedges, half of which are nailed to the wood frame at the height of each course, and the other half tapped lightly into place to complete the interlocking operation of blocks, moldings and wedges, holding the entire wall securely in place.—*Owens-Illinois Glass Company, Toledo, Ohio.*

Cement Dispersing Agent

The Master Builders Company has re-

MAHON Rolling STEEL DOORS

WILL CONTINUE TO

Protect

- from FIRE
- from WEATHER
- from INTRUSION

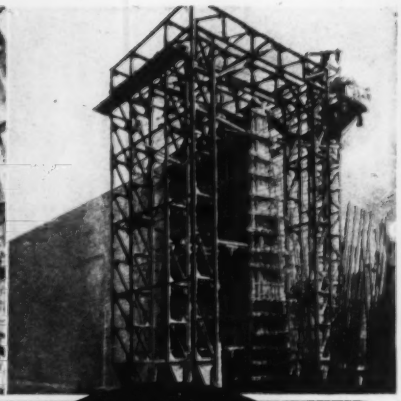
LONG AFTER THE WAR IS WON

Because of the greater protection they give and their proved serviceability, many hundreds of Mahon Rolling Steel Doors have been installed in buildings devoted to war production and service. They are functioning in outside walls, in partition walls, in corridors, in elevator shafts and as automatically-closing fire doors—wherever, in fact, complete protection from fire, weather and intrusion is essential. Based on actual records of previous Mahon installations over long years of daily operation, it is a safe prediction that each of these doors will protect and serve throughout the duration and continue to do so long after the war is over and won. Mahon Rolling Steel Doors are built to last a lifetime. See Sweet's for information on Mahon improved design and construction—or write for the NEW Mahon Rolling Steel Door catalog.

THE R. C. MAHON COMPANY
DETROIT • CHICAGO

Manufacturers of Steel Roof Deck, Rolling Steel Doors, Shutters and Grilles, Kalamein Doors, Tin Clad Doors, Cast Iron Roof Scuppers and Roof Sump Receivers.

MAHON



for Economy in Construction

BLAW-KNOX STEEL FORM Engineers offer a consultation service before plans are drawn, with the thought in mind that their specialized knowledge and experience may be of assistance to both engineers and contractors in promoting speed and economy in construction, and securing a superior quality of finished work.

This engineering service is yours for the asking.

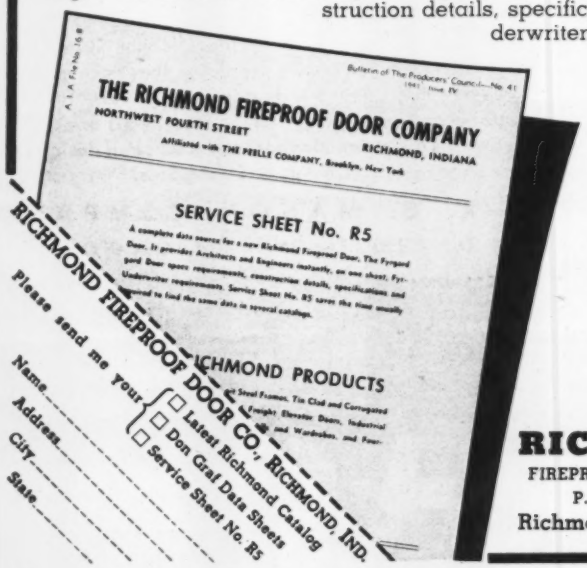
BLAW-KNOX STEEL FORMS

BLAW-KNOX DIVISION
of Blaw-Knox Company
Farmer's Bank Bldg. Pittsburgh, Pa.
New York Chicago Philadelphia Birmingham

WRITE NOW
for this helpful folder!

SERVICE SHEET R-5 IS A COMPLETE DATA SOURCE FOR A NEW IMPROVED DESIGN OF FIREPROOF DOOR, THE FYRGARD DOOR.

THIS SHEET Gives space requirements, large scale construction details, specifications and Underwriter requirements.



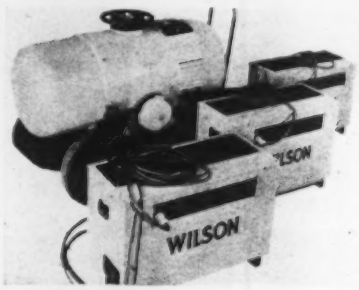
Have you received your set of RICHMOND Don Graf Sheets or our latest catalog?

The **RICHMOND** FIREPROOF DOOR CO.
P. O. Box 306
Richmond Indiana

cently placed on the mark[illegible] cement dispersing and air entrai[illegible] agent known as HP-7, which, whe[illegible] added to a paving mix, is said to imp[illegible] all the essential qualities of concrete. Furthermore, it appears that this [illegible] accomplished with little or no incre[illegible] in cost, and in some cases with actual [illegible] luction. HP-7 is essentially a combinat[illegible] of an air-incorporating agent (sodium lauryl sulphate) with a cement-dispersing agent (a derivative of lignin sulphonic acid). Maximum dispersion of cement in the mix has long been recognized as necessary to the attainment of maximum strength and economy. The manufacturer points out that as HP-7 is a mixture of definite compounds in definite proportion, its use is subject to perfect and complete control.—*The Master Builders Company, Cleveland, Ohio.*

Arc Control Stations

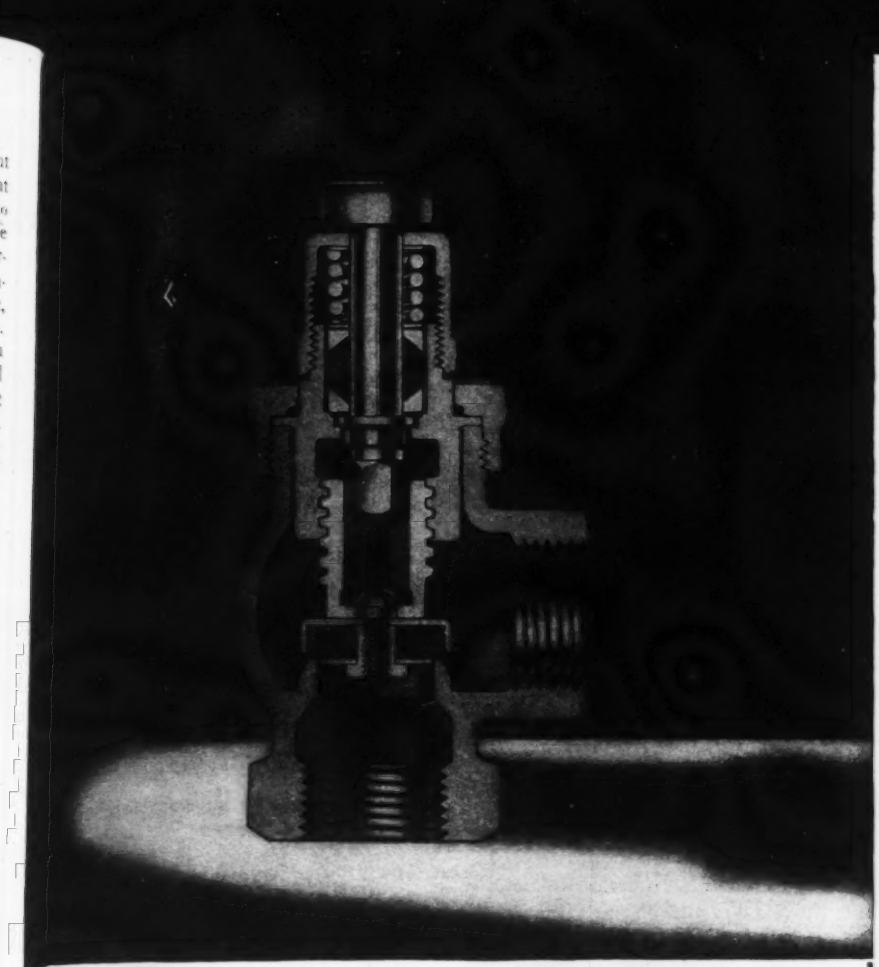
Greater welding output per machine, better control by the operator, and improved welds on thin gage metal are said to be possible through the use of the Honey Bee arc control station recently developed by Wilson Welder and



Metals Company. These arc control stations are made in capacities of 75 amp. and 150 amp. and are an auxiliary electric device, connected in series with the welding circuit of any constant potential arc welding generator. When two or more arc control stations are hooked up to a single generator, a like number of welding arcs can be operated simultaneously. Each operator can regulate his own current and weld as he sees fit without affecting the other in any way.—*Wilson Welder and Metals Company, New York, N. Y.*

Surface Grinder

A new type surface grinder, offering numerous features, has been announced by the Delta Mfg. Co. The machine is said to be versatile, easy to operate, portable, and surprisingly low in cost. Outstanding features include a unique wheel-mounting arrangement; carefully designed spindle; improved table; and a specially designed column with many outstanding features.—*The Delta Mfg. Co., Milwaukee, Wis.*



Webster ¾" 603PHF Radiator Valve

Designed for War-Time

Iron Radiator Valves

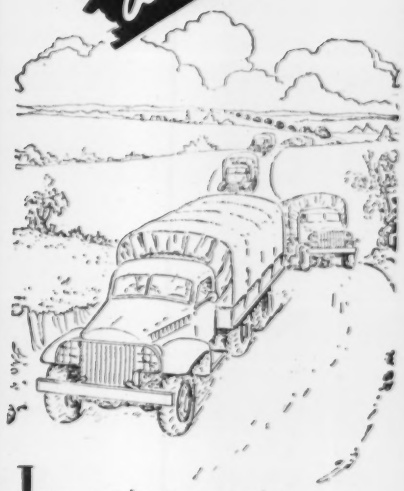
The "Old Ironsides" line of Webster Radiator Valves and Traps complies fully with the conservation and simplification program of the War Production Board. Cast iron bodies and bonnets release critical brass; unionless female inlet and outlet connections contribute metal and machine-tool hours to the Victory Program. This all-out conservation helps keep steam available for its important heating role in war-time . . . "Old Ironsides" Valves in two sizes—¾" and 1"—angle body with wheel handle. Construction is a proven Webster design, meeting "spring packless" specification—a heavy spring pressing on die-molded metallic ring packing. Non-rising stem. Quick opening . . . "Old Ironsides" Traps in three sizes—½" for 200 sq. ft.; ¾" for 400 sq. ft.; ¾" for 700 sq. ft. Traps employ time-tested Webster thermostatic element, a double diaphragm of phosphor bronze fully compensated for pressure . . . "Old Ironsides" Valves and Traps are available on appropriate priority.

Keep your present Webster Equipment in first-class condition—add years of life to your heating system—by following the practical heating advice in Webster Service Bulletin S-500-E. A copy is yours for the asking.

WARREN WEBSTER & COMPANY

CAMDEN, N. J., EST. 1888, PIONEERS OF VACUUM STEAM HEATING

STEAM Heats America—at war!



Jeeps, trucks, troop carriers . . .

Half tracks, mobile machine shops . . .

Transportation and supply for an Army of three, six, ten million men . . .

That is America's promise to the Victory Program—and America is going to beat that promise.

It calls for miles and miles of added production space.

New buildings to be heated—evenly, economically. New plants—requiring the finest heating America can provide.

For fifty years, America's best heated buildings have used steam as a heating medium . . . steam harnessed and brought under control with Webster Systems of Steam Heating.

Today, the experience of the Webster Organization in the heating of 75,000 buildings is offered to Army, Navy, Marine Corps . . . and to architects, engineers, and heating contractors working on war construction.

While Ordnance production has first call on our facilities, we are still producing Webster Steam Heating Equipment for use in the war effort.

Essential repairs for Webster Systems are available on A-10 priority, under W.P.B. Emergency Repair Order P-84. Orders should be limited to actual needs.

Warren Webster & Company, Camden, N. J.
Representatives in 65 principal Cities

Webster
Steam Heating

This is one of a series of advertisements that will tell the public of the part that Webster Steam Heating and the Webster organization plays in the war effort . . . appearing regularly in leading business, industrial, engineering and technical publications.

Amsco V-Mang Makes Cutter Head "Good as New at Half the Cost"

Restoring a broken and worn cutter head for a 12″ hydraulic dredge to a condition "as good as new and at half the cost" was accomplished by the Iowa State Conservation Commission at Storm Lake, Iowa through the use of Amsco V-Mang and Amsco No. 459 Hard Surfacing Welding Rods.

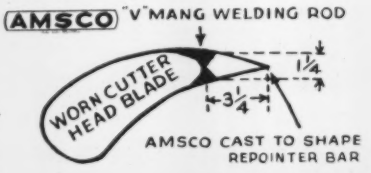
This cutter head was broken across the back rim, three tie braces were broken loose from the cutter blades, while the blades were worn to a minimum width of 3″—in fact, the cutter head was useless in its deteriorated condition.

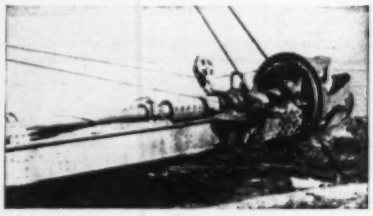
To rebuild the cutter head, cast dipper tooth repointer bars were welded to the worn blades with Amsco V-Mang; and following this operation, the cutting edge of the bars, or blades, was hard surfaced with Amsco No. 459 Hard Surfacing Material.

A careful tabulation of cost of time and materials, including hauling, electric current, etc., came to $621.70.

"*Estimated cost of a new cutter head was $1,200.00, but owing to war conditions, it was impossible to secure a new one. The work of rebuilding was done in our own shop by one of our own men. In our opinion, the rebuilt head is now equal to a new one and at approximately half the cost,*" writes J. A. Dunkel, Superintendent of Dredging, Storm Lake, Iowa.

With all-out war production preventing the replacement of much-needed equipment, you, too, can rebuild worn or broken construction, dredging or quarrying equipment parts, quickly and economically, with Amsco Welding Rods. Write for Bulletin 941-W containing money-saving application suggestions.





Above: before reclamation. Below: after building-up and hard-facing.

Amsco
AMERICAN MANGANESE STEEL DIVISION
OF THE AMERICAN BRAKE SHOE & FOUNDRY CO.
Chicago Heights, Illinois

Manganese Steel Castings for shocks and abrasion.
Chromium-Nickel Alloy Castings for heat and corrosion resistance.
Power Shovel Dippers. Dredge and Industrial Pumps.
Welding Materials for reclamation and hard-surfacing.

FOUNDRIES AT CHICAGO HEIGHTS, ILL.; NEW CASTLE, DEL.; DENVER, COLO.; OAKLAND, CALIF.; LOS ANGELES, CALIF.; ST. LOUIS, MO. OFFICES IN PRINCIPAL CITIES

Manufacturers' Activities

CHARLES C. CHAMBERLAIN has been named general sales manager of JENKINS BROS., Bridgeport, Conn., manufacturers of valves and other products. Mr. Chamberlain had been publicity manager of the company since 1940, and joined he organization in 1927, shortly after graduation from Hamilton College. He will make headquarters at the general offices, 80 White Street, New York, N. Y.

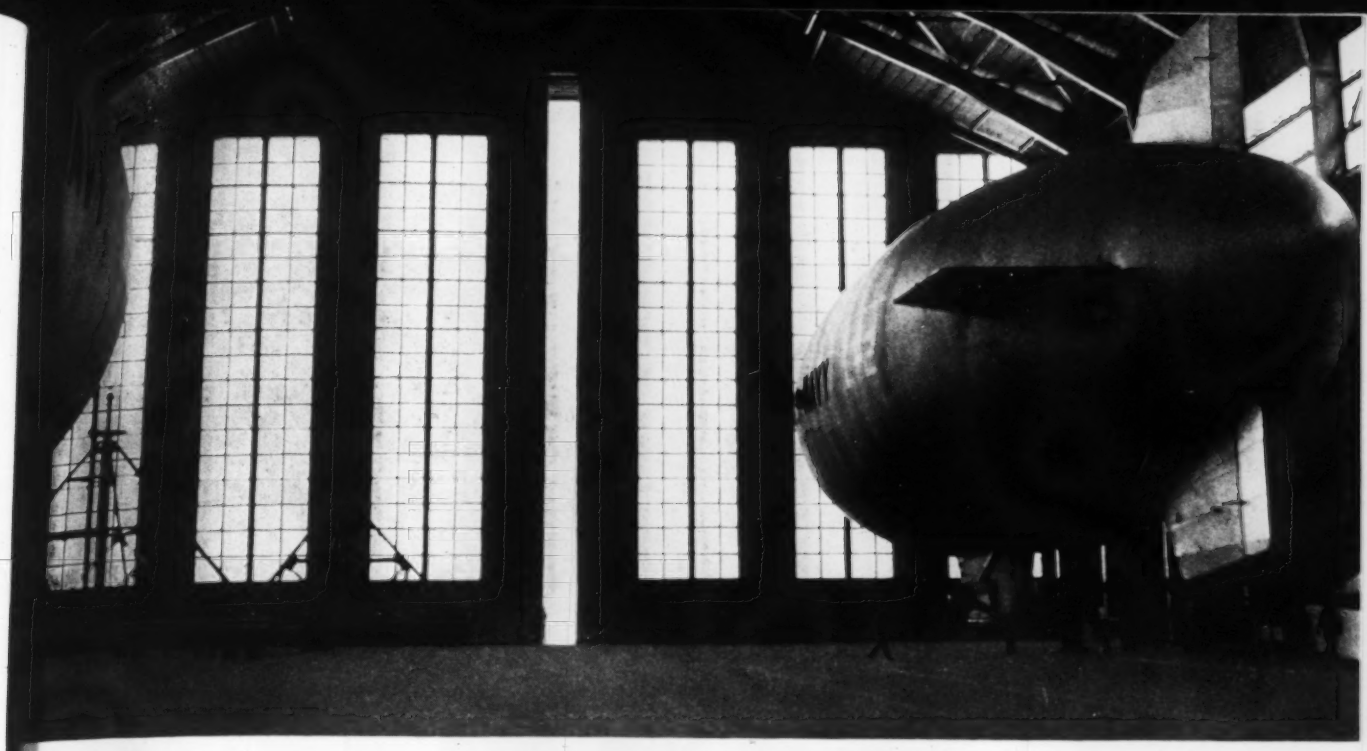
CHARLES A. BEEGLY, manager of the strip steel division of the COLD METAL PROCESS Co., Cleveland, Ohio, has been appointed a lieutenant in the Army Air Forces.

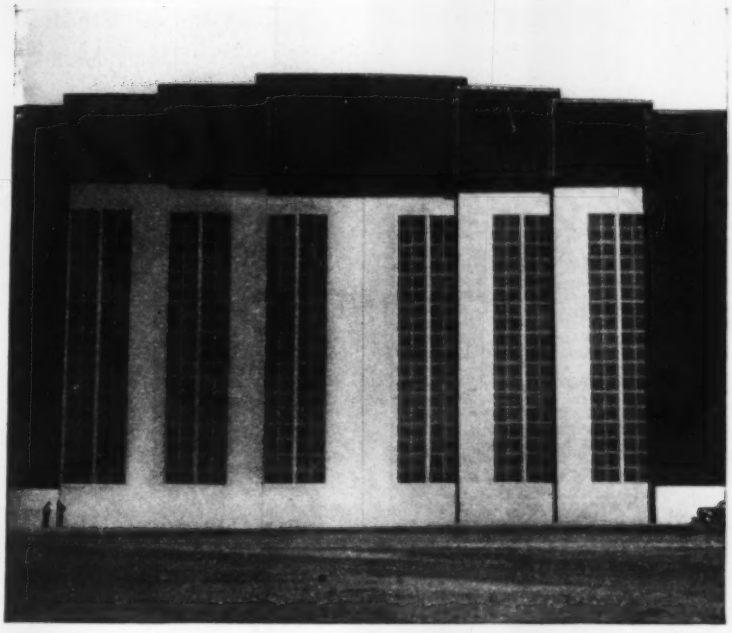
W. R. FRICKER has been appointed district engineer of CANADIAN WESTINGHOUSE Co. at Montreal. A native of England, Mr. Fricker came to Canada in 1929 as district service engineer for Canadian Westinghouse at Regina, Sask.

The MONTREAL LIGHT, HEAT AND POWER CONSOLIDATED has announced the appointment of MAJ. A. S. DAWES as a member of the board of directors, replacing the late T. B. Macaulay. Maj. Dawes is president and managing director of the ATLAS CONSTRUCTION Co., president and managing director of the BELMONT CONSTRUCTION Co., vice president of FEDERAL AIRCRAFT, LTD., and an officer in other companies in the Dominion.

J. T. BURKE, supervisor of industrial relations department at the Sharon, Pa. plant of WESTINGHOUSE ELECTRIC & MFG. Co. has been transferred to the supervisory force of the company's Canton, Ohio, plant. He is succeeded at Sharon by C. D. MOORE.

C. J. BROWN, for many years in charge of the FOXBORO COMPANY's production of pyrometers was on hand recently when representatives of the British Admiralty Technical Mission at Ottawa, Canada visited the company's plant at Foxboro, Mass., to pay tribute to the part company employees are contributing to the successful campaign of the United Nations at sea. EDGAR H. BRISTOL, president of





☆

Another installation of Byrne motorized doors . . . 155 feet wide and 90 feet high. An eight-story building a half block wide could be admitted through this opening. A small switch opens and closes the doors quickly and smoothly.

Consult Byrne engineers without obligation. Qualified by more than 20 years' experience in designing and building hangar doors, Byrne engineers will gladly co-operate in handling door problems.

For further details, see Sweet's Architectural Catalog

BYRNE doors

incorporated

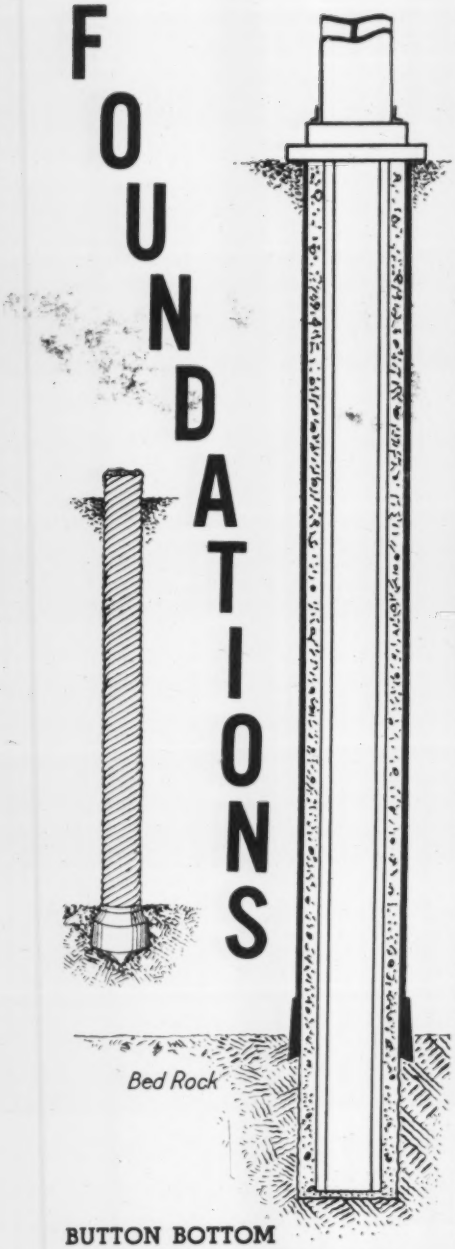
1150 Griswold St. Detroit

Cable Address: BYRNDOR

BRANCH OFFICES:

WASHINGTON, D. C.....1092 National Press Bldg.
SAN FRANCISCO, CALIF.....Builders Exchange
NEW YORK, N. Y.....101 Park Avenue

BYRNE MOTORIZED HANGAR DOORS



BUTTON BOTTOM
COMPOSITE—STEEL PILES
COMPRESSED CONCRETE
CAISSON PILES

DRILLED-IN CAISSONS

Engineers available for consultation on any foundation problem. Catalogues on request.

WESTERN

WESTERN FOUNDATION CO.
WESTERN CONCRETE PILE CORP.

308 W. Washington St. Chicago, Ill.
52 Vanderbilt Ave. New York, N. Y.

the company was another speaker at the meeting.

R. A. "Bob" Ornberg, for the past three years with the Curtis Lighting, Inc. has recently been appointed advertising manager of the American-Marietta Co., Chicago, succeeding Z. H. Mischka, who has joined the staff of Russell T. Gray, Inc.

The United States Maritime Commission Award of Merit has been presented to the American Hoist & Derrick Co. of St. Paul, Minn., for outstanding achievement in War Production.

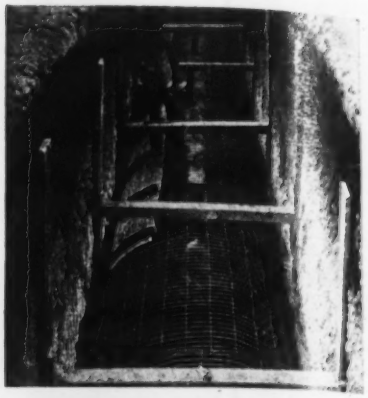
Herman Schifflin, left, manager of the Allis-Chalmers Manufacturing Co.'s crushing cement and mining machinery department since its creation in 1926, and manager of the cement machinery division since 1907, has announced his retirement from active service with the company. He is succeeded by Walter L. Maxon, right, an employee of the company since 1927, and before that a professor of metallurgy at the Colorado School of Mines. Mr. Maxon formerly was sales manager and chief engineer for the company's mining machinery division.

The Northfield Iron Company of Northfield, Minnesota, manufacturers of road maintainers, snow fence culverts and other products, has started production of a new line of street and highway signs made of noncritical material. C. J. Brown, president of the company, said the new signs are made of nicowood, a pressed wood made from long leaf pine pulp.

John A. Devereaux, Minneapolis, Minn., a member of the firm of Devereaux-Olson Co., died recently at Cody, Wyoming, while supervising construction of an internment camp there.

H. L. Watson, since 1934 executive vice-president and director of the De Laval Steam Turbine Co., Trenton, N. J., has been elected to the presidency of that company, succeeding Francis J. Arend, who died recently. Mr. Watson was formerly general sales manager.

Foote Bros. Gear & Machine Corp. of Chicago, Ill., has announced the election



WELDED FABRIC QUALITY
That Cuts Costs on Tough Jobs

UNIFORMITY of Clinton Welded Fabric, both in welding, and in tensile strength of the wire, raises performance standards, and assures maximum strength at welds. That's why experts prefer it for circular and other concrete shapes. Besides, it comes in sheets or rolls, cut to your *exact* job specifications . . . saving time and expense of on-the-job cutting. *Every step* in manufacture is completed in our own plant. From blast furnace to wire, to electrical welding, it is supervised and tested by our own experts. Wickwire Spencer Steel Company, 500 Fifth Avenue, New York, N.Y.

WISSCO PRODUCTS

CLINTON REINFORCING FABRIC
It's Electrically Welded
WICKWIRE SPENCER

"GUNITE" HOUSING

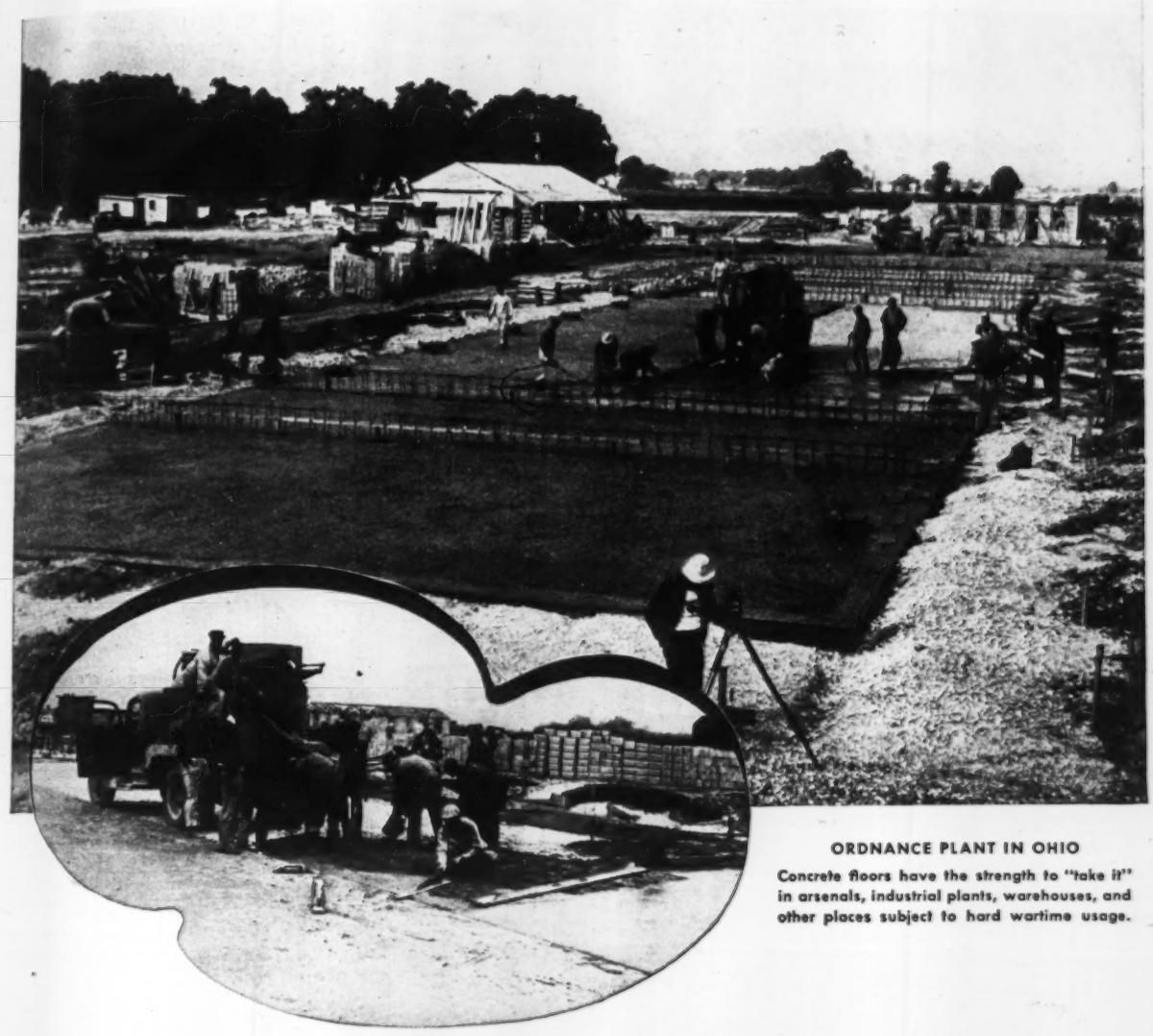
One hundred of these houses were built complete in two months, for the families of men engaged in Defense work,—"somewhere east." This speed was possible largely through the use of reinforced "GUNITE" for the exteriors.

Architects, engineers and contractors interested in quickly built housing projects should have our Bulletin 2200.

The "CEMENT GUN" can be bought by anyone, and used without restrictions.

CEMENT GUN COMPANY
Manufacturers of the "CEMENT GUN"
ALLENTOWN, PENNSYLVANIA

WE ARE ALSO "GUNITE" CONTRACTORS
LET US BID ON YOUR WORK



ORDNANCE PLANT IN OHIO

Concrete floors have the strength to "take it" in arsenals, industrial plants, warehouses, and other places subject to hard wartime usage.

War plants expedited by plain concrete

floors on ground

War plant construction is often aided these days by building floors on ground with concrete. Steel is seldom needed. The bulk of the material is usually available locally, with minimum transportation. Big floor areas can be completed rapidly and used as a working platform for other construction operations.

And after assembly lines start rolling, concrete's strength and durability help maintain the nearly-perfect floor conditions so vital to plant efficiency.

Where a high light-reflection factor is desired to improve lighting conditions, a white portland cement concrete topping is easily provided.

Our technical staff is ready to assist designers and builders on floors and all types of war construction. The information sheet described below may be helpful in expediting your job and getting maximum service from concrete.

PORTLAND CEMENT ASSOCIATION
Dept. 10d-17, 33 W. Grand Ave., Chicago, Ill.

Please send me free information sheets checked:

☐ *"Concrete Floors on Ground,"* covering subgrade, slab design, jointing, placement, finishing, curing.

☐ *"White Cement Floors,"* giving construction data.

Name _____

Organization _____

Address _____

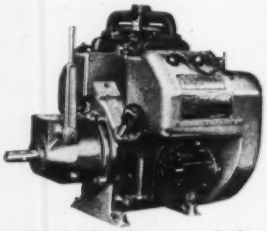
City _____ *State* _____

NO Horsepower "Watering" chores

"Horsepower", in its original natural state, must have water. But the maintenance burden and trouble risks of water-cooling for modern *engine horsepower* is something we can do without . . . *without* sacrificing heavy-duty dependability, efficiency, or economical operation but rather, *improving all three* . . . plus the advantage of less weight and fewer critical-material parts.

WISCONSIN HEAVY-DUTY AIR-COOLED ENGINES are designed for all-out serviceability on all counts . . . on any kind of equipment that can be operated advantageously within a 1 to 35 hp. range.

AIR-COOLED



Model VE-4, V-type, 4-cylinder, 22 hp., air-cooled Wisconsin Engine. Weight: 285 lbs.

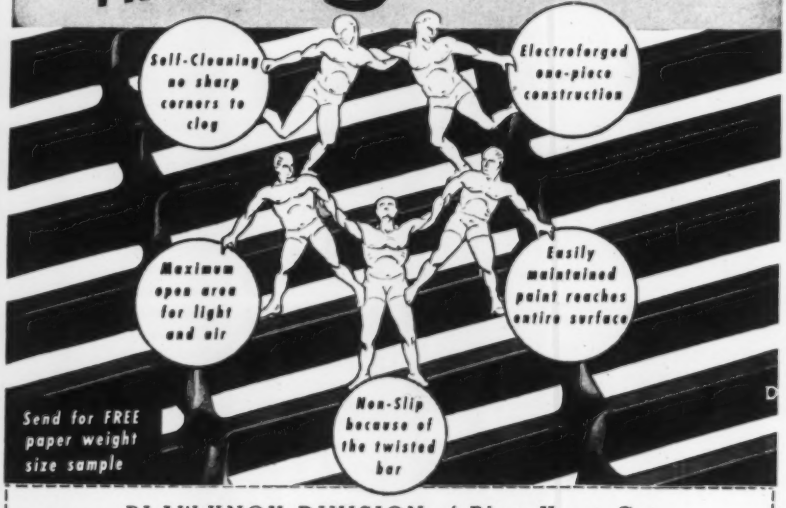
MOST POWER Per POUND

WISCONSIN MOTOR Corporation

MILWAUKEE, WISCONSIN, U. S. A.

World's Largest Builders of Heavy-Duty Air-Cooled Engines

BLAW-KNOX GRATING PRESENTS 5 OUTSTANDING FEATURES


Self-Cleaning no sharp corners to clog
Electroforged one-piece construction
Maximum open area for light and air
Easily maintained paint reaches entire surface
Non-Slip because of the twisted bar
Send for FREE paper weight size sample

BLAW-KNOX DIVISION of Blaw-Knox Co.
2001 FARMERS BANK BUILDING · PITTSBURGH, PA.

NAME_____

STREET_____

CITY_____ STATE_____

of RUSSELL G. DAVIS to the vice-presidency of the company. Mr. Davis will continue as well in his capacity as general manager of the industrial gear division. Other promotions within the company include: F. A. EMMONS, now assistant general manager; R. B. Moore, manager, sales and engineering; W. H. OSTRING, special representative; GALEN BUTTERBAUGH, speed reducer sales; T. F. HILL, gear sales; and CHARLES LOOK, assistant, gear sales.

GEORGE L. RANDALL, advertising manager of the WICKWIRE SPENCER STEEL Co., for the past year, has been appointed public relations manager.

A new sales district for the national sales and service division of the B. F. GOODRICH Co. has been established for the Pacific Coast area, with the exception of Seattle, and DONALD W. FAIRBAIRN has been named district manager. Headquarters will be in Los Angeles.

A. W. THOMAS, (shown here), sales manager of the construction machinery division of CHAIN BELT Co., has been granted leave to become a consultant for the Construction Machinery Division of the War Production Board. During his absence, his duties will be taken over by D. A. KALTON, assistant sales manager of the division.

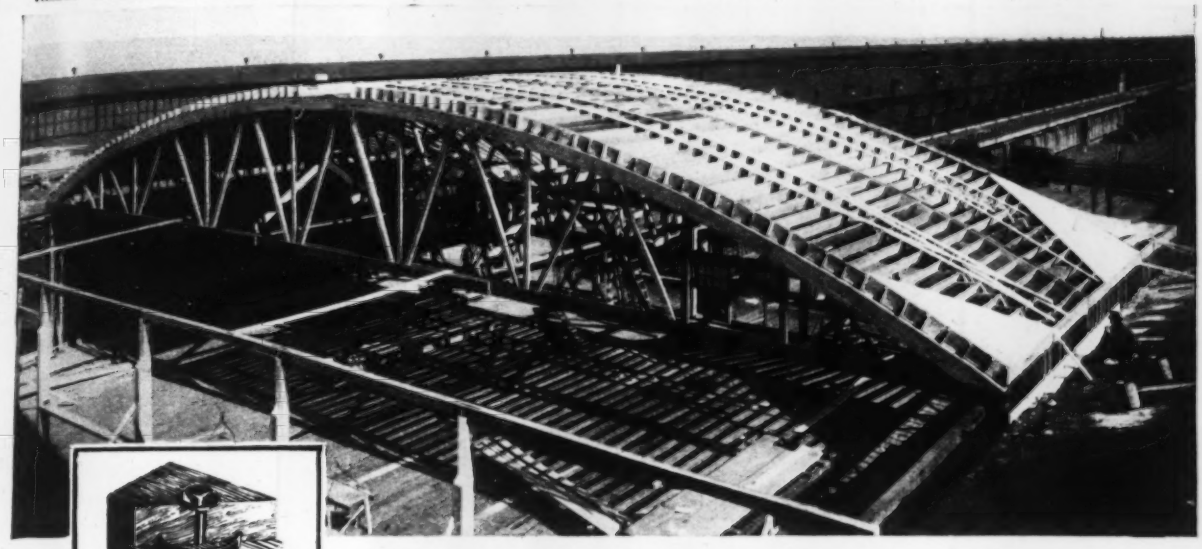
Something new in the matter of keeping salesmen and customers advised of new tricks and new uses for products is the publication "The Hell We Can't," inaugurated by the MESKER BROS. IRON Co., St. Louis, Mo. Starting out as a four-page folder, the publication has reached six pages and expects to go higher. It includes hints from salesmen to other salesmen on how to substitute "service" for sales, hints to users on substitute materials, and offers general assistance to its readers in working out their war problems.

WILLIAM T. HEDLUND, president of the ELASTIC STOP NUT CORP. has announced the appointment of WHITNEY C. COLLINS, as vice-president in charge of sales policy. Mr. Collins, a resident of Beverly Hills, Calif., has been a director of the company since 1940.

THE UNIVERSAL CRUSHER Co., a Delaware corporation, with factories and general offices at Cedar Rapids, Iowa, has changed its name to the UNIVERSAL ENGINEERING Co., organized under the laws

Engineered TIMBER Will Build It!

TIMBER TRUSSES DESIGNED AND PREFABRICATED BY McKEOWN BROTHERS COMPANY, CHICAGO, AND ERECTED AT CHICAGO'S MUNICIPAL PIER.



TECO Ring Connectors spread the load on a timber joint over practically the entire cross-section of the wood.

Under the TECO System of construction, timber has become an engineering material with many structural advantages...plus speed and economy of erection

Spanning 111 feet, these timber trusses are typical of many thousands . . . short span and long span . . . now being prefabricated with TECO Connectors.

For the TECO Ring system of prefabricating timber . . . of using timber professionally as an engineering material . . . fulfills today's urgent demand.

It endows the joints with great strength while reducing, at the same time, the size of members used. It eliminates most of the bolts, plates and angles formerly used in heavy construction. It builds factories, hangars, bridges, warehouses, docks, and derricks in less time, with less labor, and at less cost.

Write today for full details.

Timber ENGINEERING COMPANY
WASHINGTON, D. C. PORTLAND, OREGON

FLEXPEDITE

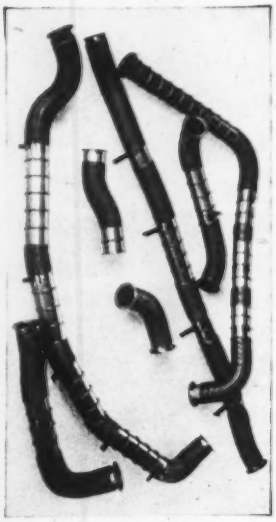
Your Conversion Assembly Production

with

REX *Flexible* METAL HOSE

In REX Flexible Metal Hose you have an immediate solution for your re-design problems where compactness and flexibility are imperative. Plus this, you conserve materials because REX Flexible Continuous Lengths Metal Hose eliminates the need for long lengths of piping and pipe joints. It enables engineers to simplify designs—provides the means for solving fluid and gas handling problems—speeds manufacture by facilitating assembly. There are easily attached fittings for every requirement. REX Flexible Metal Hose withstands flexing and vibration and assures better product performance.

Utilize this range of adaptability—write for data and engineering recommendations on specific problems involving flexible connections.



REX-WELD Corrugated Flexible Metal Hose.
REX-TUBE Interlocked Flexible Metal Hose.
REX-FLEX Stainless Steel Flexible Tubing. AVIO-FLEX Oil Line Hose. CELLU-LINED Hydraulic Hose.

COPYRIGHT, 1942, CHICAGO METAL HOSE CORPORATION, MAYWOOD, ILLINOIS

CHICAGO METAL HOSE CORPORATION

General Offices: MAYWOOD, ILLINOIS

Factories: Maywood and Elgin, Ill.

of the State of Iowa. Officers, executives and personnel remain the same, and nothing is being eliminated from the line of equipment manufactured by the original firm.

H. V. PUTMAN, manager of the WESTINGHOUSE ELECTRIC Co. transformer division, has been elected a vice-president of the company.

With the distinction of being the first war industry plant in Kentucky to receive the Army-Navy "E" flag for outstanding production efficiency, TUBE TURNS, of Louisville, Ky., recently held ceremonies in front of its plant. W. H. GIRDLER, president of the company, is shown here as he received the plaque from representatives of the armed forces.

H. A. BRUNO AND ASSOCIATES, 30 Rockefeller Plaza, New York, N. Y., have been appointed relations and employee relations counsel for JENKINS BROS., Bridgeport, Conn.

LESTER M. SEARS, president of the TOWMOTOR COMPANY, recently was on hand to represent its organization in the award of the Army-Navy "E" plaque, presented by Col. William H. Clopton, veteran of two wars.

THOMAS ARCHER WATSON, president of the WATSON GUNSIGHT CO., LTD., and inventor of many scientific instruments, died at Toronto, Ontario, recently. He was 74.

Substitution of glass bottles for tin cans in packaging certain petroleum specialty products and lubricants which will divert to the current nationwide tin conservation drive 255 tons of tin plate a year, has been announced by the STANDARD OIL COMPANY OF INDIANA. Sprays, polishes, auto cleaners and waxes and cream separator oils are among the products packaged in tin cans which Standard will market in the future in glass bottles.

WILLIAM E. CLOW, 82, chairman of the board of JAMES B. CLOW & SONS, died recently at his home in Chicago, Ill. With his father, Captain James Beach Clow, Mr. Clow—then 18—formed a partnership and started the new firm under the name of James B. Clow & Son. Later as his brothers entered the firm, the name was changed to James B. Clow & Sons.

J. H. HATCHER has been appointed assistant to the vice president, and R. P. JOBB has been appointed manager of the

SYMBOL OF A PLEDGE UPHELD

TODAY, from the flagstaff of
the Thor plant in Aurora, Illinois
there flies the "E" Banner
representative of the joint
Army-Navy Production Award,
signifying excellence on both
Army and Navy production.

And, proudly, Thor employees
wear the "E" lapel pin.

Fully aware is every man and woman
of Thor of the significance of
the honor which has come to them.
They regard it, humbly, as
the symbol of a pledge upheld.

* * *

MONTHS ago, the men and women of Thor gathered in the shadow of the plant and made a pledge.

The pledge was, "*We'll Produce the Plus.*"

It was a pledge made solemnly by determined people who knew that the portable power tools they make would help to build the planes, the tanks and the ships with which the war must be won.

Months ago, they rejected the thought that "*Too little, too late*" could be applied here.

That's why shipments leaving the plant have doubled, then doubled again . . . have resulted in more tools produced than anyone ever thought possible.

In our own way . . . in the only way we know how . . . we have added our part to the industrial effort that is so necessary for the fighting of battles wherever conflict rages.

For this reason, we look upon the award of the Army-Navy "E" as symbolic of a pledge upheld.

* * *

TO you, the users of Thor tools,
we report this conferring of the
Army-Navy "E"
with the stern realization that
our task is just begun.

Not while a plane is delayed
in its departure,
not while a ship lies waiting
on the ways,
not while a needed shell
is uncompleted,
can there be any feeling of
satisfaction or accomplishment.

Today, with even greater
determination, we reaffirm
our purpose and now pledge . . .

"We'll Exceed the Need!"

Thor *Portable Pneumatic and Electric Tools*

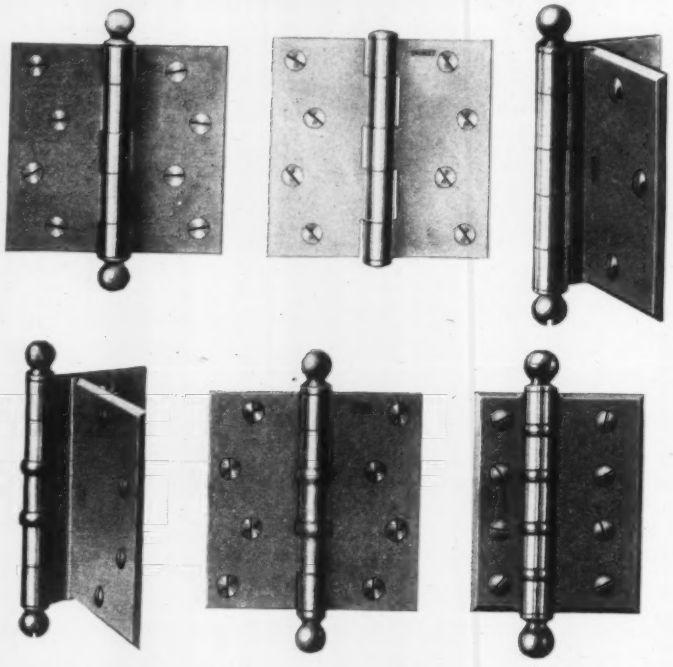
INDEPENDENT PNEUMATIC TOOL COMPANY

600 W. JACKSON BOULEVARD, CHICAGO, ILL.
Branches in Principal Cities

S • GRINDERS • HAMMERS • SAWS • NIBBLERS • SCREW DRIVERS • POLISHERS • SANDERS • NUT SETTER

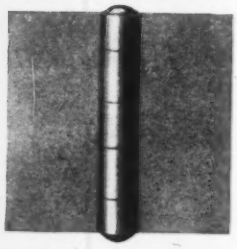
Look to STANLEY for BUTT HINGES

for every type and size of DOOR



SEND FOR COPY OF STANLEY HARDWARE CATALOG NO. 61

It is the handiest reference book for building hardware. Shows the complete line. Write for a copy. The Stanley Works, New Britain, Connecticut.



STANLEY

TRADE MARK

HARDWARE FOR CAREFREE DOORS

DRILLING CONTRACTORS

DIAMOND AND SHOT CORE BORINGS—DRY SAMPLE BORINGS

•

Foundation Testing for Bridges, Dams and All Heavy Structures

Also

Manufacturers of Diamond and Shot Core Drills, Accessories and Equipment

•

SPRAGUE & HENWOOD, Inc.

SCRANTON, PA. Dept. E U. S. A.

NEED A BIG Trailer?

La Crosse Makes Them Up To 200 Ton Capacity-

** WRITE OR WIRE **

LA CROSSE TRAILER & EQUIPT. CO.

LA CROSSE WISCONSIN U. S. A.

development service for the ATLANTIC COAST LINE RAILROAD.

WILLIAM A. MCKINLEY, formerly chief sales engineer of the MIDLAND STEEL PRODUCTS CO., Cleveland, has been elected vice president in charge of sales for that company.

DR. FRANCIS C. FRARY, director of research for the ALUMINUM RESEARCH COMPANY of America, New Kensington, Pa., has announced that HERMAN F. BAKKEN has been made associate director.

HENRY A. ROEMER, JR., (shown below) formerly manager of sales of steel and wire products for the PITTSBURGH STEEL COMPANY has been promoted to assistant general manager of sales. NORMAN F. MELVILLE, formerly assistant manager of sales in the steel and wire products division, has been made manager of sales in that department, succeeding Mr. Roemer.

JOSEPH W. MILLARD, 56, president of the EXTRUDED METAL PRODUCTS CO., Bridgeport, Ohio, died there recently.

The GENERAL BRONZE CORPORATION of New York City has announced that ROBERT P. BREESE, formerly of the Bendix Products division of BENDIX AVIATION CORP., has joined their organization as industrial development engineer.

Among the many firms which recently have received the much coveted Army-Navy "E" flag for excellence in production are: the AMERICAN MACHINE & METALS CO., INC., East Moline, Ill.; the CHAIN BELT CO., Milwaukee, Wis.; ALUMINUM INDUSTRIES, INC., Cincinnati, Ohio; W. & L. E. GURLEY, Troy, N. Y.; The WELLMAN ENGINEERING CO. of Cleveland, Ohio; and the five Pittsburgh area plants of the WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

EDWARD F. VINCENT of Montreal, Quebec, has been elected a director of LASALLE BUILDERS SUPPLY, LTD. in addition to his duties as manager of the company's refractories department.

JAMES F. TWAMLEY, vice president in charge of sales for the COPLAY CEMENT MANUFACTURING CO. has retired and has been succeeded by PETER J. LOUGHRAN, in the capacity of general sales manager.

CHARLES M. COHN, president of the CONSOLIDATED GAS ELECTRIC LIGHT & POWER CO., of Baltimore, Md., has been ap-

WATER SUPPLY, sewerage and drainage have become vital factors in this Global War. Huge Shipbuilding Yards, new War Industries, Naval Bases, Airports and Cantonments can only function when they are adequately supplied with water and drainage facilities.

Reinforced Concrete Pressure Pipe for water supply lines and oil pipelines and Plain or Reinforced Concrete Pipe for sewers, culverts and airport drainage, have been filling an ever increasing demand for pipes which would provide the greatest utility and permit the maximum conservation of steel, iron and other critical materials.

Lock Joint Pipe Company is justly proud of its part in this All-Out War Effort. By greatly expending our facilities we have produced hundreds of miles of pipelines for War Projects which have resulted, during the years of 1941 and 1942, in the conservation of enough tonnage of steel and iron to build *One Battleship • One Heavy Cruiser • One Destroyer • One Submarine.*

Truly, WE'RE IN THE NAVY NOW!

LOCK JOINT PIPE COMPANY

Established 1905

AMPERE, NEW JERSEY

Denver, Colo. · Chicago, Ill. · Kenilworth, N. J. · Kansas City, Mo. · Rock Island, Ill.
White Plains, N. Y. · Valley Park, Mo. · Cleveland, Ohio · Hartford, Conn. · Navarre, Ohio

SCOPE OF SERVICES *Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply Mains as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous lines.*

LOCK JOINT
Reinforced Concrete
PRESSURE PIPE

Today WORKING FOR VICTORY

Tomorrow

Universal PRODUCTS for Concrete Construction

Will help you build a new world

Today—famed Universal products are playing a vital part in the war building program—saving time and effort in connection with a wide variety of products which range all the way from concrete ammunition storage magazines to new networks of concrete highways. We are happy to thus play our full part in hastening victory—and happy, also, that our facilities, at this time, are sufficiently expandable to enable the acceptance of additional orders for production. Available, also, is a competent engineering advisory service.

Universal PRODUCTS INCLUDE:

The following Universal products for concrete construction represent only a partial list—from a line designed to fit every need of owners, architects and contractors.

FORM TIES

SPIROLOCS—*for all-around use.*
TWISTYES—*for lighter type jobs.*
FORM CLAMPS—*to meet special construction problems.*

SPECIALTIES

BAR SUPPORTS—*for reinforced concrete structures.*
DOWEL SUPPORTS—*for reinforced road construction.*

TODAY—WRITE FOR CATALOG

It's free—and will prove helpful in solving some of your most vexing concrete construction problems—today and tomorrow.

Universal Form Clamp Co.
CHICAGO
Branches and distributors in all principal cities

pointed a member of the Trade and Industry Division of the Baltimore War and Community Fund Campaign.

THE COOPER-BESSEMER CORP. announced recently it had surpassed its increasing monthly production goal for the fourth consecutive month. B. B. WILLIAMS, corporation president, complimented the men in all departments on their excellent record in turning out diesel and gas engines and compressors for war use.

HAROLD L. TILTON, who has been with the Boston division of SHELL OIL CO., INC., as sales engineer in the asphalt department, has been transferred to the Chicago, Ill. division.

Employees of the INDEPENDENT PNEUMATIC TOOL CO. of Aurora, Ill., received the Army-Navy Production Award for outstanding war production recently.

C. S. REDDING, president of LEEDS & NORTHRUP CO., recently awarded a war bond to employees who won a production slogan contest sponsored by the company. The winning slogan "V Depends on Me" was submitted by JOHN T. NEVITT, JR., an inspector in the factory.

LONE STAR CEMENT CORP. has announced the appointment of PURD B. WRIGHT, JR., as manager of its "Incor" Division and as advertising manager, succeeding DEWEY THOMPSON, who resigned recently.

R. C. VAUGHAN, president of the CANADIAN NATIONAL RAILWAYS, has been appointed chairman of the railway's board of directors.

DAVID S. YOUNGHOLM, vice president, has announced the appointment of RALPH R. BRADY as manager of the commercial engineering department, WESTINGHOUSE ELECTRIC & MANUFACTURING CO.'s lamp division at Bloomfield, N. J. Mr. Brady succeeds D. W. ATWATER, who recently was appointed manager of the new illuminating engineering department.

COL. HENRY C. NUTT, 79, retired president and general manager of the MONONGAHELA RAILROAD, Pittsburgh, Pa., died recently at Cambridge, Mass.

The MEEHANITE METAL CORP. of Pittsburg has granted manufacturing rights for Meehanite castings to three industrial concerns in South Africa: ACME IRONFOUNDERS LIMITED, Johannesburg; The PRETORIA BRASS & IRON FOUNDRY, Pretoria; Messrs. MORRIS AND MARTIN, LTD., Port Elizabeth.

Just Published:

MODERN CAMOUFLAGE

THE NEW SCIENCE OF PROTECTIVE CONCEALMENT

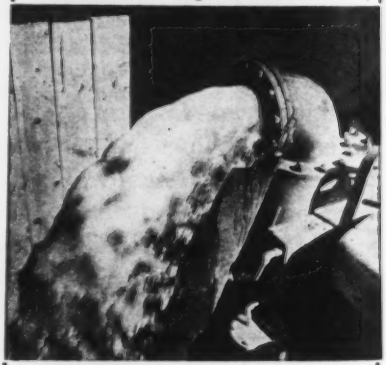
by Major Robert P. Breckenridge

WRITTEN by an engineer officer active in the camouflage section of the army, and reviewed and passed by the War Department and the Office of Civilian Defense. 132 photographs, drawings and diagrams supplement the text, and make this a practical book for expert or layman. Everyone responsible for the safety of factories, public utilities, cities, public buildings, road and rail transportation, military areas and air fields will find it invaluable.

At all bookstores, $3.50; or sent postpaid on receipt of remittance by the publishers, Farrar & Rinehart, Dept. N.R., 232 Madison Ave., New York. (May be returned for refund within 10 days if not satisfactory.)

CMC DUAL PRIME CENTRIFUGAL PUMPS

EXTRA SERVICE FROM PRESENT EQUIPMENT!



The simple design and ease of maintaining and servicing CMC equipment are features that mean money in the pockets of owners today. Your nearest CMC distributors is ready to help you get EXTRA SERVICE from your present equipment. Call on him.

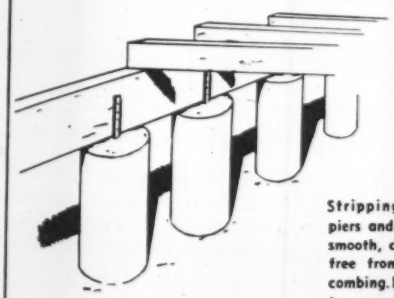
CONSTRUCTION MACHINERY CO.
WATERLOO, IOWA
Cable Address—OPARO, N. Y.

Strong, light, easily handled and can be stored outdoors.

Quickly cut to length with ordinary power or hand saw.

Easily installed and braced in position with ordinary tools.

Strength to withstand any concrete pour or tamping.



Stripping exposes piers and columns smooth, clean and free from honeycombing. No pointing necessary

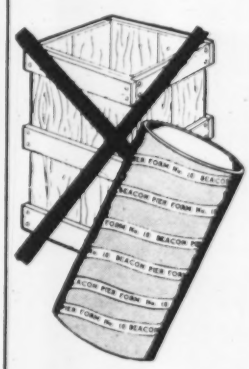
SPEED

WITH THE

NEW FIBER

BEACON PIER FORM

✓ *Prefabricated to your Specifications*
✓ *Approved by the U. S. War Dept.*
✓ *Made of Non-critical Materials*
✓ *For Immediate Shipment*



More economical and efficient than wood forms. Uniform in size. Fiber especially fabricated for the purpose; treated outside for weather resistance; treated inside to prevent concrete adhesion and permit easy stripping; treated at ends to prevent "wick action". Tremendously strong to withstand any pour and any tamping . . . hand or mechanical. Easily installed with ordinary tools. No oiling needed. Stripping exposes concrete as smooth and clean; no honeycombing; no pointing.

HOW TO ORDER

Standard Sizes in Stock

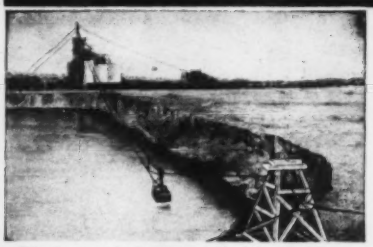
For Piers 8" x 8"—Specify Type No. 8
For Piers 10" x 10"—Specify Type No. 10
For Piers 12" x 12"—Specify Type No. 12
For Piers 14" x 14"—Specify Type No. 14

Other Sizes to your Specifications

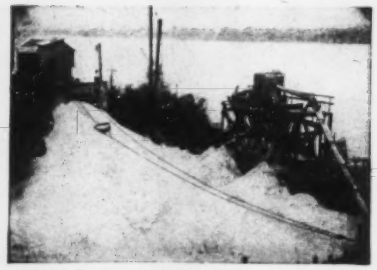
WRITE, OR WIRE FOR QUOTATIONS

BEACON STEEL PRODUCTS COMPANY, INC.
12 EAST FORTY-FIRST STREET, NEW YORK

More Yards per Dollar



This 2 cu. yd. Sauerman Slackline Cableway digs down to the bottom of a deep gravel deposit and hauls the material to the top of screening plant at rate of 90 cu. yd. per hour.



Small Sauerman Drag Scraper stockpiles crushed silica rock on ground alongside washery and reclaims this stored material when and as required to drying plant.

For over 30 years SAUERMAN Cableway Excavators, Power Drag Scrapers and Tower Machines have dug, moved, and placed earth, gravel, clay, blasted ore, sand, rock and coal on thousands of different jobs all over the world.

Increase your profits by taking advantage of the economies available with SAUERMAN Machines such as: versatility, fast handling, one-man operation, extremely low power and maintenance costs, and reliable, steady service.

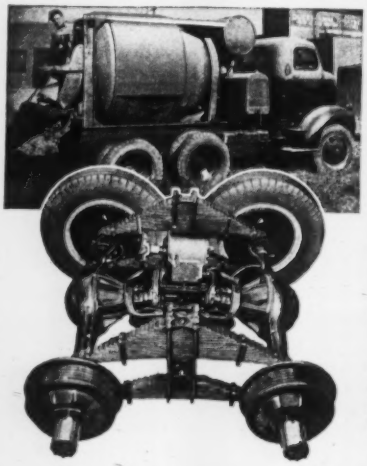
These machines come in a wide range of sizes with capacities up to 600 cu.yd. per hour and spans up to 1500 ft.

SAUERMAN BROS., INC.
532 S. Clinton St. CHICAGO

Sauerman LONG RANGE MACHINES

RUGGED and DEPENDABLE HEAVY-DUTY TRUCKS from SMALLER UNITS

. . . and Uncle Sam Approves!



YOU NEED BIG-CAPACITY, HUSKY TRUCKS for today's jobs . . . but you can't buy standard equipment of this type now.

QUITE A PROBLEM? NO!

For years successful operators with tough, difficult, heavy duty, on or off-the-highway hauling problems have saved time, money, men and material with

THORNTON Four-Rear-Wheel DRIVE

From coast to coast in the U. S. A. and in countries all over the world, 1½ to 3-ton trucks have been converted with THORNTON units into DURABLE, FLEXIBLE, HEAVY DUTY VEHICLES that out-pull, out-last and out-maneuver standard trucks costing double or more.

Put TWO driving axles under the load instead of one, double the gear speeds, better springing and load flotation, with vastly superior tractive ability . . . all of this for less money!

Government approval? Yes, up to now. But these things are subject to change . . . so act quickly. Contact your nearest Truckstell-THORNTON dealer, or wire factory direct. Trained men will engineer this equipment to the requirements of YOUR PARTICLAR JOB.

THORNTON TANDEM CO.
8729-8779 GRINNELL AVE. DETROIT, MICH.
Manufacturers also of the THORNTON automatic-locking DIFFERENTIAL
"When you need TRACTION you need THORNTON"

NEW PUBLICATIONS

Instrument catalog—Catalog 95-A, just issued by The Foxboro Company, is said to be the most comprehensive bulletin the company has ever issued, describing the full line of instruments for measurement and control of industrial process conditions. The contents have been prepared with great care for completeness and accuracy, and the catalog is organized to make it easy for the user to choose the type of equipment best fitted to his needs. There are over 200 illustrations in the 48-page, 10-section booklet.—*The Foxboro Company, Foxboro, Mass.*

Steels—A complete combined list of standard steels of the American Iron and Steel Institute and the Society of Automotive Engineers, Inc., has been issued by the Babcock & Wilcox Tube Co., as a new Technical Data Card.—*Babcock & Wilcox Tube Co., Beaver Falls, Pa.*

Woodwork Care—"Pointers on Care of Woodwork", a pocket-sized folder prepared as a result of a nation-wide survey by Ponderosa Pine Woodwork, contains 48 important pointers on the care of woodwork. These 48 rules compiled from leading woodwork manufacturers, dealers and contractors, point out the importance of preservative treatment for all exterior woodwork; and give instructions on the care of windows, frames, interior trim, cabinets and other woodwork.—*Ponderosa Pine Woodwork, 111 W. Washington St., Chicago, Ill.*

Flooring—Nothing is omitted from this informative new four-page bulletin on factory flooring put out by the Flexrock Company. It tells how to cover rough concrete or wood floors, platforms, aisleways, ramps and steps, how to make feather-edge patches without chipping out old concrete; each operation is clearly planned and photographically illustrated so that anyone can make permanent repairs with the least possible effort.—*The Flexrock Company, 23rd & Manning Streets, Philadelphia, Pa.*

Work—"Keep 'em Working" is the title of a new book published by Caterpillar Tractor Company to aid owners of Caterpillar products in getting the most out of their machines. Supplementing operator's instruction books, "Keep 'em Working" gives the reasons behind the maintenance and operation instructions, goes into greater detail on the care of certain critical parts and gives general information not conveniently available elsewhere.—*The Caterpillar Tractor Company, Peoria, Ill.*

Housing Terms—The National Bureau

Drill and Build Faster WITH SKILSAW DRILLS on all War Construction!

When you think how many holes must be drilled on a single big project, you'll realize how important SKILSAW DRILLS can be to you in rushing war construction. The seconds they save on each operation mount up to days saved on whole contracts . . . days that will help bring Victory *sooner!*

SKILSAW DRILLS are faster because they are more powerful. They're lighter, more compact and easier to handle on all drilling from lightest lead holes for screws to heaviest reaming. 23 POWERFUL MODELS. Ask your distributor for a demonstration of SKILSAW DRILLS on your own work.

SKILSAW, INC. • 4771 Winnemac Avenue • Chicago, Illinois
New York • Boston • Buffalo • Philadelphia • Cleveland • Detroit
Indianapolis • St. Louis • Kansas City • Atlanta • New Orleans
Dallas • Los Angeles • Oakland • Seattle • Toronto, Canada

SKILSAW PORTABLE ELECTRIC TOOLS
★ MAKE AMERICA'S HANDS MORE PRODUCTIVE ★

SKILSAW DRILLS speed up timber boring. Light, compact, powerful. May be used with or without auxiliary side handle.

Mounted in a Bench Drill Stand, SKILSAW DRILLS do lead-hole drilling, counter sinking and thru-drilling faster, better.

SKILSAW DRILL (½ in. Heavy Duty) Model 83 speeds all heavy boring in roof truss construction up to 1¼ in. in hard wood.

Use R B & W Bolts and Nuts . . .

Quick-starting, quick-tightening because they are accurately, uniformly sized and threaded — and carefully inspected.

Vibration-resisting, shock-resisting because the manufacturing method insures extra strength, and all processing is controlled from raw rod to finished product.

EMPIRE BOLTS NUTS RIVETS AND ALLIED FASTENING PRODUCTS . . . SINCE 1845

RB&W Making strong the things that make America strong

Russell, Burdsall & Ward Bolt and Nut Company. *Factories at* Port Chester, N. Y., Rock Falls, Ill., Coraopolis, Pa.; *sales offices at* Philadelphia, Chicago, Detroit, Chattanooga, Los Angeles, San Francisco, Portland, Seattle

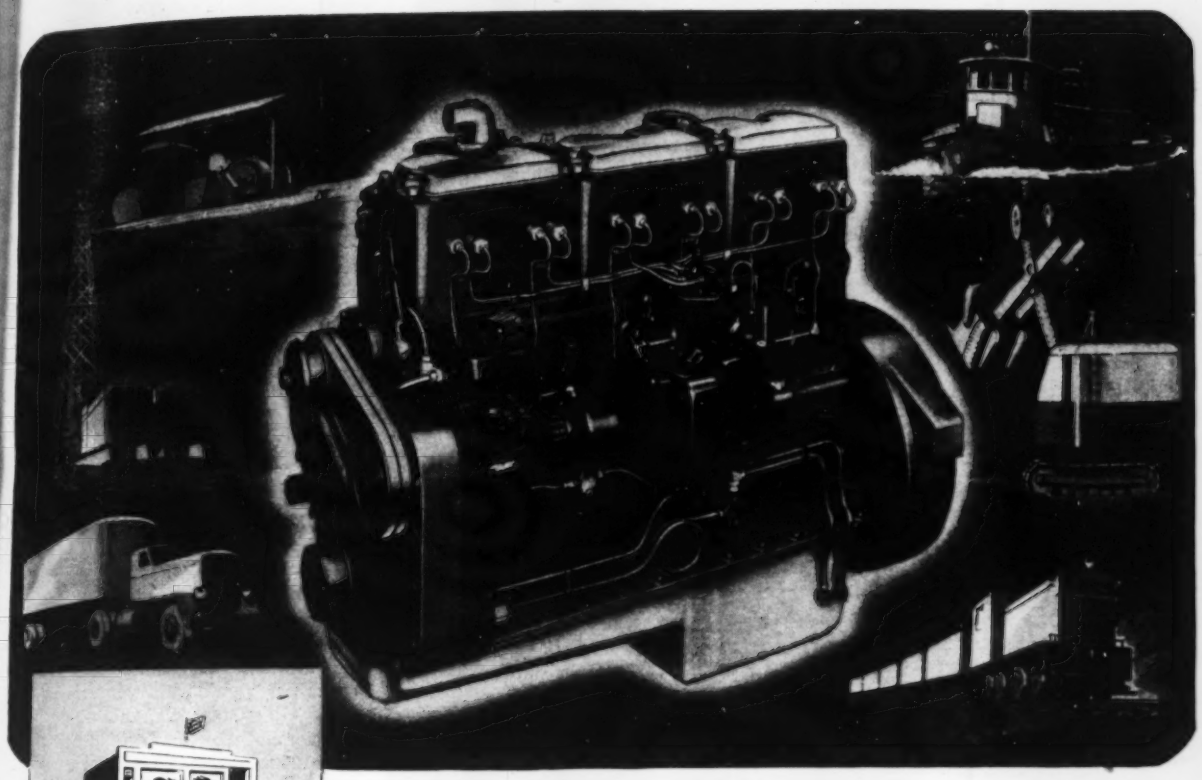
of Standards, Department of Commerce, has announced the publication of its Building Materials and Structures series, of a Glossary of Housing Terms in which is presented a large number of expressions found in housing literature. The publication was prepared by a committee composed of members of various federal housing agencies, the purpose being to bring together, for the convenient use of all interested persons, definitions that are generally accepted and currently used. This is a revision and expansion of a publication issued in 1937. Additions are most extensive in the fields of considerable confusion exists regarding landscape and construction work, where many definitions. — *Superintendent of Documents, Government Printing Office, Washington, D. C.*

Lubrication—"A Guide to Better Bearing Lubrication" distributed by the SKF Industries, Inc., fills a vital need in all industries. Thirty-two pages are filled with designs, formulas, and graphs which explain the highly technical text. Subjects treated include the functions of lubrication, oil lubrication, recommended viscosities, oil supply systems, etc.—*SKF Industries, Inc., Philadelphia, Pa.*

Repairs—Containing an illustrated step-by-step procedure for making repairs on conveyor belts by the use of portable electric vulcanizers as one of its principal features, a new booklet, "Rubber Conservation for Users of Industrial Rubber Belting," has just been published by the B. F. Goodrich Co., and is now available upon request. The general theme of the booklet is saving of rubber in plants, and it is divided into interesting subheadings of the general title, including "Rubber Can Be Saved by Making Vulcanized Repairs Promptly," "Rubber Can Be Saved by Salvaging Belts for Smaller Drives," "Rubber Can Be Saved by the Plylock Splice," and others.—*The B. F. Goodrich Co., Akron, Ohio.*

Installation Care—A set of seven bulletins has been prepared and distributed to the trade in an effort to help both those who cannot buy motors now and those who are working on high priority jobs by the Century Electric Co. The bulletins are written to cover installation and care to help the user and insure getting the longest possible service. A system of suggested checks are offered to eliminate first one thing and then another to assist in locating trouble when something goes wrong, or the motor or generator does not operate.—*Century Electric Co., 1806 Pine St., St. Louis, Mo.*

Arc Welding — "Arc-welding Acces-



INDEPENDENTLY OWNED DEALERSHIPS

COMPLETE PARTS STOCKS

FACTORY TRAINED MEN

OWNERS MANUALS AND SERVICE BULLETINS

CUMMINS *Dependable* DIESEL

TO NEW MEN AND OLD TIMERS

Since 1932, when the first high-speed Cummins Diesel was offered to the public, the Cummins Customer Service Plan has been in active operation.

This plan consists of five major features:

1. Independently owned dealerships whose very existence depends upon their ability and willingness to serve any purchaser of a Cummins Diesel to his complete satisfaction.

2. Complete parts stocks available at centrally located points, eliminating duplication and consequent incomplete stocks.

3. Competent, factory-trained men who are ready and willing to advise and instruct mechanics, or handle any service problem which may arise.

4. Easily understood Operator's Manuals which give complete instructions for a preventive maintenance program with detailed answers to every emergency question. (To non-owners, the price of this book is one dollar.)

5. Service Bulletins covering day-to-day developments and improved practices recommended through the continuous personal contact of direct factory representatives with owners and mechanics throughout the country.

If you are not taking full advantage of this 5-point Cummins Customer Service Plan, to make your Cummins Diesel work better . . . longer . . . for less money . . . why not get in touch with your Cummins Dealer today?

CUMMINS ENGINE COMPANY · COLUMBUS, INDIANA

YOURS FOR LOW-COST PRODUCTION

Union-Formed Wire Rope

Because **Union-Formed** (pre-formed) Wire Rope is free from internal stress, it is much slower to fatigue under the combined stresses of constant bending. In service over small sheaves or wherever bending is severe, **Union-Formed** will far outlast ordinary rope and effect a real money saving. Write or wire.

UNION WIRE ROPE CORPORATION
2134 Manchester Ave. Kansas City, Mo.
Tulsa • Houston • Chicago • Salt Lake City
New Orleans • Monahans • Portland • Ashland, Ky.

UNION Wire Ropes

The "ULTIMATE LOW COST WIRE ROPE"

WRITE FOR ROPE DOPE

This periodical bulletin of wire rope facts will be sent you without charge.

5-42

FASTER • BETTER • STRONGER

HYDRO-TITE FOR BELL & SPIGOT PIPE JOINTING

Hydro-Tite is a dependable self-caulking sulphur-base compound for jointing water mains and soil pipe—costing less than lead—requiring no skill to make tight joints. Same crew can lay more pipe per day. Stands deflection and vibration. In use 30 years without failure.

Write for Jointing Book.

HYDRAULIC DEVELOPMENT CORP.
50 CHURCH STREET — NEW YORK, N. Y.

sories" is the title of an attractive new 32-page bulletin (GEA-2[illegible]B) recently issued by the General Electric Co. Well illustrated throughout, the bulletin presents a most complete list of General Electric accessories, all designed to make arc-welding safer and easier. Among the listed items are goggles, observation shields, ventilated head protectors, chrome-leather protective clothing, flame-proofed welding screens, ultraviolet-ray protective paint, and many others. Also listed is General Electric's 200-page arc-welding manual.—*General Electric Co., Schenectady, N. Y.*

Circuit Breakers—15,000 volt oil circuit breakers for indoor service, classes 150-TCR-3 and 250 TCR-3, are described and illustrated in a new 12-page publication, Catalog 3350, released by the Roller-Smith Co. These breakers are of the oil tight single round tank type, single throw, and are available in 2 and 3 pole designs. Class 150-TCR-3 breakers are available in 600 and 1200 ampere capacities and have an interrupting capacity of 150,000 kva. Class 250 T CR-3 breakers, which can be furnished in 600, 1200 and 2000 ampere ratings have an interrupting capacity of 250,000 kva. The catalog lists the various sizes of breakers with their interrupting ratings, closing and tripping currents, amount of oil required and approximate shipping weights. Control diagrams, methods of tripping and dimensional data also are given.—*Roller-Smith Co., Bethlehem, Pa.*

Equipment—Ingersoll-Rand has announced a new 42-page publication entitled "Equipment for Quarries and Contractors." It is a handy, pocket-sized booklet containing 72 illustrations and numerous data on rock drills, detachable bits, reconditioning equipment, hose lines, hoists, pumps and air compressors. The language is entirely non-technical, and the reader will find many hints that may help save time and labor. —*Ingersoll-Rand Co., 11 Broadway, New York, N. Y.*

Synthetics—A new bulletin No. 1620, brings up-to-date and contains complete easily understandable technical data on "Tygon", a synthetic rubber-like material produced by the United States Stoneware Company. "Tygon", said to be a miracle synthetic, is being accepted throughout industry.—*The United States Stoneware Company, 60 East 42nd Street, New York, N. Y.*

Rust—A 20-page catalog on rust preventive paints has been released by the Rust-Oleum Paint Corporation. It contains directions for the proper application of rust preventive coatings, color chips illustrate the variety of products

BACKING UP THE YANKS ON OVER 30 FRONTS

The whole world is our battlefield in this war! To win we have to knock out the enemy wherever he is! You find Yanks in the Solomon Islands, China, Madagascar, India, Egypt, the Belgian Congo... and every other place that's a battlefield today or tomorrow! We've got to get there "firstest with the mostest." And come hell or high water, we shall not fail to deliver the goods.

American draftsmen, engineers and architects rely upon Dixon *Typhonite* ELDORADO to help them crystalize the material of war. ELDORADO's *sharp opaque unmistakable* lines make easy-to-read blueprints. Yes, ELDORADO as a drawing pencil is doing its part to help America shorten this war by days, weeks, months, years!

ELDORADO

PENCIL SALES DEPARTMENT, 227-J10, JOSEPH DIXON CRUCIBLE COMPANY, JERSEY CITY, N. J.

Speed

a must for war work -that's why you need

SMITH AIR COMPRESSORS

★ Lightweight ★ Flexible ★ Move them easily from one job to another

Here's a way to speed-up your work—to save money! Replace large, cumbersome compressors with lightweight Smiths for a majority of compressor operations. 60 cu. ft. size uses only 1 gal. of gasoline an hour. Made with FORD MOTORS and standard parts, the ruggedness and efficiency of these famous compressors are sources of constant satisfaction to users everywhere. Wire, phone or write today for complete information!

With a Ford Motor and shop facilities you can assemble your own Smith Compressor. We will furnish a Smith Compressor Head and Accessories with complete instructions for mounting.

Write for free Booklet

GORDON-SMITH & CO.
INCORPORATED

430 College St., Bowling Green, Ky.

available and explanations of where and how these materials may be used to insure maximum protection. The catalog includes descriptions of special coatings designed to inhibit the corrosive action of fumes, humidity, brine, etc. and special applications to be used where wide variation in temperature require unusual elasticity. There are also brief catalog descriptions of industrial wall and floor enamels for inside and outside use, house paints, asphalt paints and sealers. —*Rust-Oleum Paint Corporation, 2425 Oakton Street, Evanston, Ill.*

Plastics—"Plastic Parts for War Production" is a new folder issued to show war-busy engineers some of the many plastic products available to replace metal and other critical materials in wartime.—*Creative Plastics Corp., 963 Kent Avenue, Brooklyn, N. Y.*

Paving Joints—A new booklet, A-42, describing concrete paving joints, joint action, dowel requirements, comparative dowel efficiency, rectangular dowels and containing specifications and other figures has just been issued by the W. S. Godwin Co. as advance pages of the booklet "Protect the Joints—Insure the Paving." A similar advance contains detailed descriptions on the action of expansion joints.—*W. S. Godwin Co., Inc., Race & McComas St., Baltimore, Md.*

Wiring—The Wiremold Company has announced the publication of a new catalog and wiring guide No. 16. This new catalog, presented in simple and practical form, is said to be more complete than previous editions, placing emphasis upon the many important war-time industrial applications of wiremold products, and including new items, such as the No. 2127P polarized receptacle and the No. 2127S universal type receptacle, designed to take plugs with either parallel or tandem blades.—*The Wiremold Company, Hartford, Conn.*

Cement Dispersion—a recent paper, "Economics of Cement Dispersion," has been issued by the Master Builders Company. Notable technological advances having far-reaching effect are referred to as horizons of a new industrial era. Efficiency and improvement such as industry has never known before are said to result from this development.—*The Master Builders Company, Cleveland, Ohio.*

Masonry Saws—A folder showing new models of Clipper masonry saws now available, and detailing some of the various cuts and other work that the machine can do is now available.—*The Clipper Manufacturing Co., St. Louis, Mo.*

Lift Truck—Production and management alike will find both their funda-

KEEP YOUR CONVEYOR BELTS GOING

FLEXCO H D RIP PLATES are used in repairing rips and patching conveyor belts. Their use saves expensive replacements and extended shutdowns.

FLEXCO H D BELT FASTENERS make a strong, tight butt joint with long life. Recessed plates embed in belt, compress belt ends and prevent ply separation. Six sizes in steel and alloys.

● Avoid shutdowns and lengthen the life of your conveyor belts and bucket elevator belts by using Flexco belt fasteners. Thousands of companies have stepped up the performance of conveyor lines and cut costs by using Flexco methods.

Bulletin F-100 shows exactly how to make tight butt joints in conveyor belts with Flexco. Also illustrates step by step the latest practice in repairing rips and putting in patches.

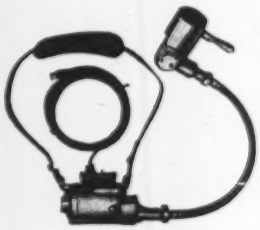
FLEXIBLE STEEL LACING CO.
4658 Lexington St., Chicago

Write for your copy.

FLEXCO HD BELT FASTENERS

Sold by supply houses everywhere

"BERG"
CONCRETE SURFACERS



Model RC1-A

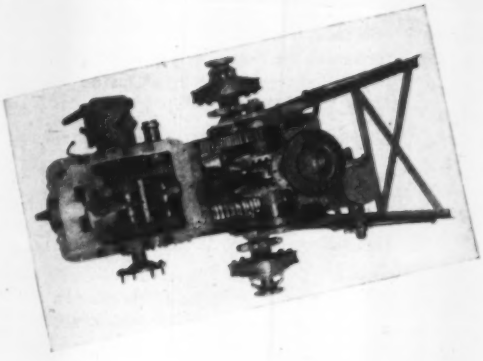
Concrete Surfacers, Concrete Vibrators and Hi-Way Surfacers—for concrete construction.

Cleaning, grinding, wire brushing, sanding and polishing equipment for use on wood and metal surfaces.

Available in electric motor and gasoline engine driven models.

THE CONCRETE SURFACING MACHINERY CO.
4667 Spring Grove Ave.
Cincinnati, Ohio

PARSONS



The compact, highly efficient Parsons transmission insures long trouble-free hours of uninterrupted operation. No dust can get in to cause rapid wear and damage to the machinery. Friction is practically eliminated so that full horse power is always delivered to the bucket line.

Cut Distances Between Pipe Line Terminals

Pipe lines, especially those being placed now, must be laid out to join terminals with the least possible distance between. This means that engineers can't be too much concerned over terrain or ground formations. That's why they depend on Parsons Trenchers to dig the trenches. Parsons Trenchers are designed for all kinds of service and thrive on the tough jobs. They handle the wide deep ditches as economically and efficiently as the easier shallow trenches. Fully enclosed gearing and ample power make Parsons Trenchers handle more work and last longer. Save time and money on your pipe line trenching with a Parsons.

THE PARSONS COMPANY, NEWTON, IOWA

TRENCHING EQUIPMENT

HOW TO BE SURE

NATURE'S AIR RAIDS

WON'T INTERFERE WITH VITAL WAR PRODUCTION!

★ ★ ★ ADEQUATE protection of vital war production against delays or shutdowns due to accident or sabotage is an important consideration today. The hazards of lightning should not be overlooked. Lightning is Nature's method of making an air raid, can act like either an incendiary bomb or a demolition bomb. Yet West Dodd can provide security easily and at reasonable cost.

West Dodd Lightning Protection and static control installations are widely used on Army Ordnance Plants. They are helping safeguard ammunition loading lines, standard magazines, underground magazines and bag loading buildings. Many important industrial plants have equipped their power stacks with West Dodd Protection.

WEST DODD RELIABILITY

West Dodd represents a consolidation of the 12 old line manufacturers of lightning protection. Including the famous Dodd & Struthers Company, pioneer of modern lightning protection equipment and certified methods of installation. This wealth of experience in designing, building and installing lightning protection, plus a long-proved record of responsibility, are plus factors in choosing West Dodd for the job.

For Further Details Write or Wire

TELEPHONE OR TELEGRAPH TODAY!

WEST DODD

LIGHTNING CONDUCTOR CORP.

GOSHEN, INDIANA

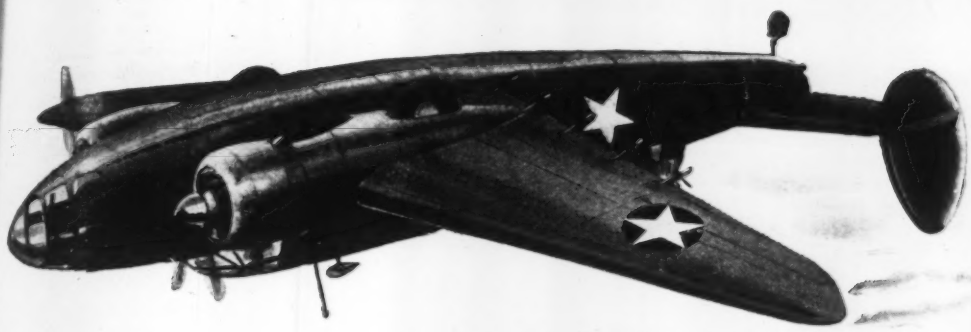
mental and controversial questions about lift truck equipment answered clearly and concisely in a new, complete manual just issued by Towmotor Company. Believed to be the most comprehensive analysis ever developed in the industry, "The Inside Story of Towmotor" explains what a lift truck really is, tells what performance can be expected of it, and sets up logical yardsticks of comparison enabling purchasers to determine whether the equipment they are considering is most suitable for their particular handling problem. The booklet is divided into six complete chapters, each of which gives thorough, authoritative treatment to factors in each individual section and interprets their role in the over-all performance picture.—*Towmotor Company, Cleveland, Ohio.*

Metallizing—The Metallizing Company of America has just issued a new data and operating manual, the Mogul Metallizer Process, to assist users of metallizing equipment in the proper operation of metal spray guns.—*Metallizing Company of America, 1300 West Congress Street, Chicago, Ill.*

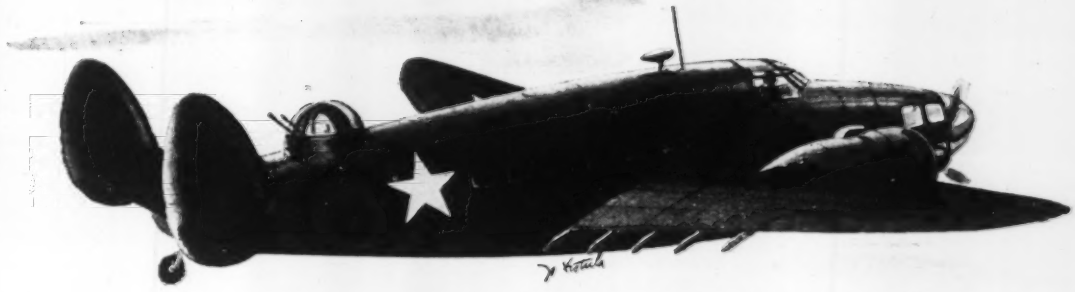
Drop Cable—Actual experience in many plants shows that bus drop cable installations are flexible, dependable and time-saving, according to a folder issued by General Cable Corporation. The Corporation's bus drop cable is designed for transmitting power in factories where a flexible and extensible connecting circuit is desired between an overhead open or enclosed fixed bus and the electrical motors running machinery such as lathes or punch presses.—*General Cable Corp., New York, N. Y.*

Saving Oil—A booklet "How to Save Fuel Oil," which has been prepared by the Petroleum Industry Committee, District No. 2, appointed by the Petroleum Coordinator for National Defense, is now available. The fact that there is likely to be a shortage of fuel oil this coming winter, due to shortage of transportation facilities, is the central point for the booklet. It contains a list of fifty-two ways of conserving fuel and heat and is distributed free to all users of fuel oil.—*Petroleum Industry Committee, 624 South Michigan Avenue, Chicago, Ill.*

Pyrometers—Leeds & Northrup have just reissued their catalog on Micromax Thermocouple Pyrometers. In 56 well illustrated pages, this book trys to cut correspondence and to give war-time pyrometer users first hand the information they want about available instruments—indicators, recorders and controllers—and about the thermocouples and accessories which are used with them.—*Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia, Pa.*



Upside down or right side up . . .



at 20° below or 100° above

Without electricity, no modern bomber could ever leave the ground.

Electricity starts the motors, retracts the landing gear, changes the propeller pitch, works the wing flaps, opens the bomb doors, powers the radio and inter-communication system, operates the instruments, gives light for the crew.

No ordinary electrical apparatus can handle these jobs in a bomber. The whole complicated system must work as well upside down as right side up. It must function in a tropical thunderstorm and in 20° below zero altitudes. And it must be designed to save every precious fraction of an ounce and inch.

Developing electrical equipment for bombers—and producing that equipment in quantity—is a job that's made to order for Westinghouse "know how."

Here are some of the Westinghouse products that are going into American bombers today:

- **Instruments that are designed so one instrument does the work of two, without any increase in size or weight.**
- **Radio equipment and special blind-flying devices that enable a bomber to fly and navigate under the worst possible weather conditions.**

- **Electric motors that develop more horsepower per pound than any other motors ever built.**
- **Instrument lighting that casts invisible rays on dial markings. These rays make the dials glow so softly they don't hinder the pilot's vision as he glances back and forth from the instrument panel to the dark sky.**
- **Electric generators each of which weighs only 42 pounds, yet produces as much electricity as 35 standard automobile generators weighing 23 pounds each**

In making these things, the long-range work of Westinghouse Research and Engineering Laboratories has played a significant part. Discoveries in many fields—in electronics, physics, chemistry, mechanical and electrical engineering—are now bearing fruit in the production of better and more powerful weapons of war.

Many of these discoveries, we believe, will someday help to make a better peacetime world.

★ ★ ★

This advertisement has been reviewed by Government authorities, and contains no information of military value to the enemy.

Westinghouse

PLANTS IN 25 CITIES—OFFICES EVERYWHERE

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, PITTSBURGH, PA.

Nothing Counts Now But ★ *Winning the War* ★

Water conservation helps—more than you may realize! Keep valves and hydrants in perfect condition to CONTROL water, to avoid leaks and waste. Thus you save on unnecessary pumpage, fuel, labor and chemicals needed for water treatment. If you are entitled to get Valves, Hydrants and other items of Water Works Equipment — investigate SMITH, with its long record of perfect service. Now being installed on Government work, industrial plants, municipalities. Standard in many big cities.

★ **WRITE FOR EXPERT ADVICE**

Waterworks men are urged to write us for any desired advice on maintenance or installation problems. No obligation. Ask, too, for Bulletins on Smith Equipment, for post-war planning.

The A. P. Smith Mfg. Co.

East Orange New Jersey

7 So. Dearborn St., Chicago, Ill.
409 Texas St., El Paso, Texas
315 N. Crescent St., Flandreau, S. D.
901 Wm. Oliver Bldg., Atlanta, Ga.
59 Oak Vale Ave., Berkeley, Calif.
524½ First Ave. S. Seattle, Wash.
1317 Oakley St., Orlando, Fla.

. . . If you want to make speed profitably . . . GET DEPENDABLE EQUIPMENT *. . Buy the Fast . . .*

JACKSON Hydraulic Concrete Vibrator

DESIGNED TO "TAKE IT" 3 SHIFTS A DAY EVERY DAY

- Automatic pressure lubrication—requires no attention.
- 34-ft. hose—2¾" vibrator head.
- Adjustable frequency to 6800 R.P.M.—submerged in concrete.
- Powerful gas engine—4.7 H.P.
- Long-lived, ball-bearing, rotary, hydraulic pump.

USED EXCLUSIVELY BY MANY LARGE DEFENSE CONTRACTORS

ELECTRIC TAMPER & EQUIPMENT CO.

LUDINGTON, MICHIGAN

TRENDS IN THE NEWS

Transportation problem grows with rationing

Nationwide gasoline rationing, coupled with rubber rationing which already has brought a 50 percent increase in bus and streetcar traffic during the last year, brings to cities today their greatest transportation problems.

Most important of these involve providing additional facilities for riders and speeding up of traffic movement, according to a survey of 22 representative cities by the International City Managers' Association.

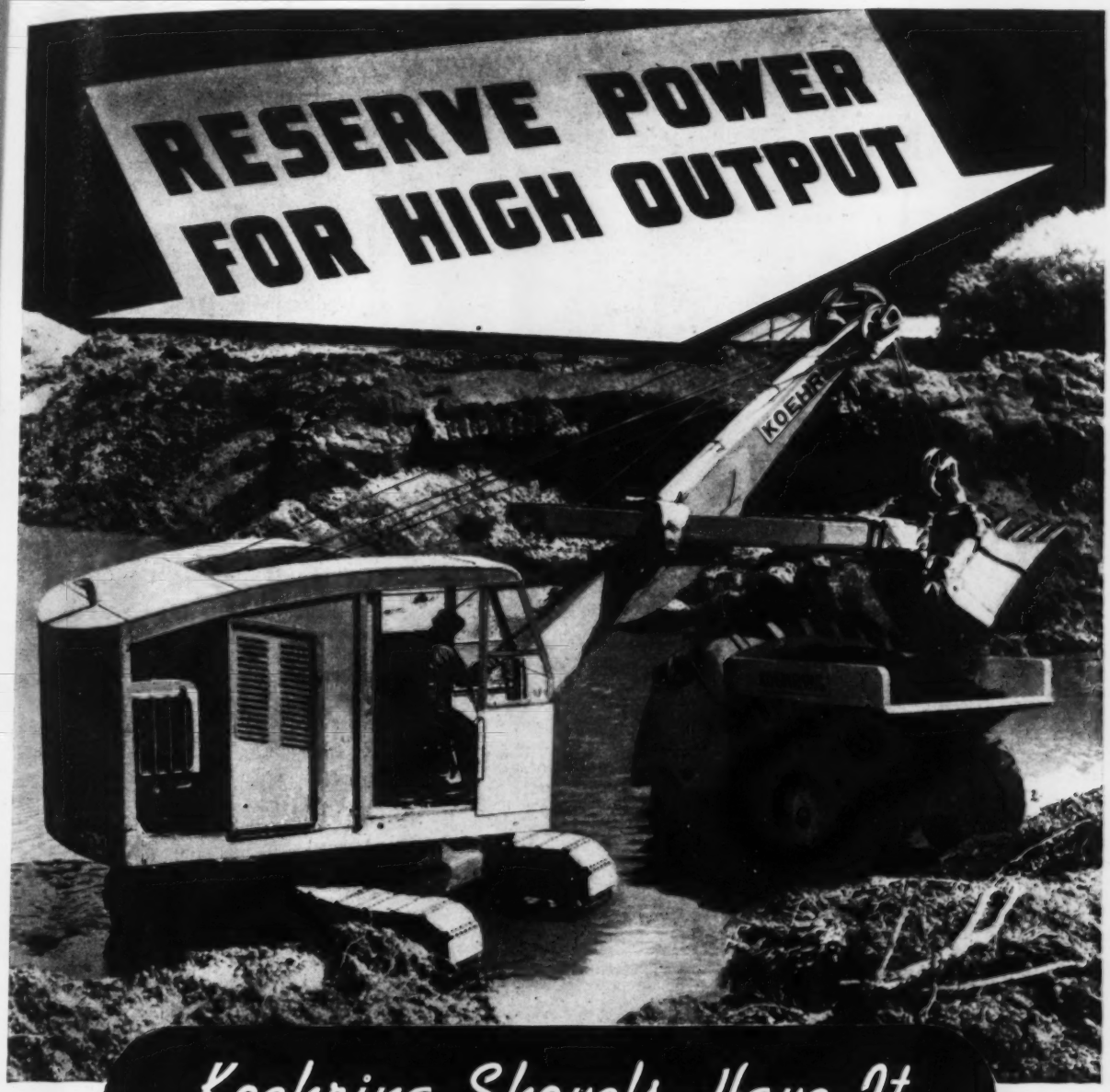
Passenger traffic in the cities increased from 15 percent in Cleveland to 275 percent in Amarillo, Texas, with greatest increases occurring in smaller "boom towns." The conductor's "step to the rear, please" fails to help in many cities, and new buses and streetcars, and even new lines, have been added. Detroit, which owns its own street railway system, put on 230 new vehicles and San Diego added 161.

Old equipment—both buses and streetcars—was brought back into use in several cities; Detroit, for example, renovated 150 streetcars.

Despite rising costs of operating public transit systems, caused by increased wages and additional equipment, these utilities have entered a period of prosperity through greater paying loads, reduction in stops and faster operation. Wage increases of from three to 30 cents an hour were reported by some of the 22 cities, but no fare increases were reported as effected or in prospect.

Transportation administrators or committees have been appointed in eleven of the 22 cities to handle transit problems, and all 22 have made special efforts to promote more effective use of private automobiles, particularly through group riding. School hours and municipal office hours have been staggered in several localities and business hours in a few, though the chief factor in spreading riding peaks, according to the survey, has been full 24-hour operation of war production plants.

Several of the 22 cities established more one-way streets during rush



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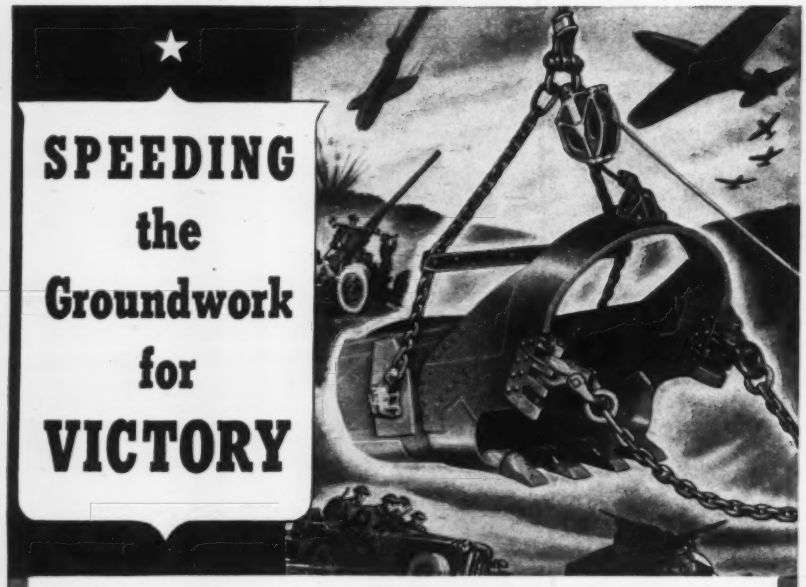

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hours to keep traffic flowing, while four cities are experimenting with shifting the timing of traffic control devices to favor streetcars and other transit units. Many cities reduced the number of stops on bus and streetcar routes, increasing speed and reducing costs. Only one or two have added trailers to buses.

Attempts to solve the problem have been "exploratory," relying mostly on private action, according to the survey. From now on, remedies tried will require more official municipal direction, and will come to include relocating residences of workers close to their employment and utilizing waste space in private dwellings for workers in nearby plants.

• • •

Detroit Zoning Ordinance amended to meet war needs

To secure housing for war workers pouring into the city and, at the same time, preserve advantages gained by zoning controls, Detroit is amending its zoning ordinance to permit roomers in residential neighborhoods, but definitely for duration of the war only.

Detroit, like many other war-industry communities with zoning controls, according to the American Society of Planning Officials, has found its zoning board of appeals besieged by petitioners for "variances" made necessary because of the war. Many of the petitions relate to use of single-residences as rooming houses; others have to do with business or industrial use in areas zoned as residential.

The Detroit amendment was proposed after the Detroit city plan commission, the Detroit housing commission and the mayor's defense housing fact-finding committee estimated that living quarters would be needed for approximately 47,000 single persons and couples coming into the city to work by the middle of next year.

The city's 21-month old zoning ordinance forbade the renting of rooms in one-story and two-story single-family residence districts.

The amendment will permit rooms to be rented in private residences in these areas for the duration of the war and six months after. A special permit must be obtained from the department of buildings and safety engineering before a temporary

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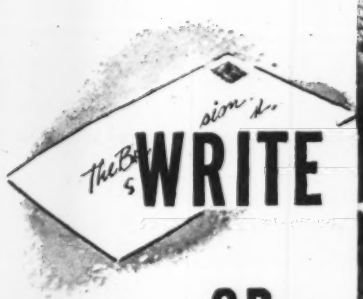

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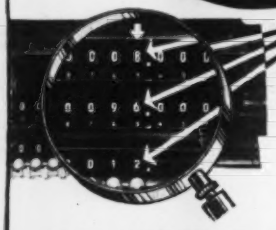

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Use margin of page if necessary

rooming house can be opened.

Additional provisions in the amendment assure return of single residence districts to their former status after the war. No physical changes may be made in the dwelling except necessary repairs or alterations that do not change the character of the dwelling and no cooking facilities may be provided for roomers. The dwelling, also, must be occupied by the family renting the rooms.

Other provisions of the amendment are that no more than three rooms may be rented and no rented room may be occupied by more than two persons. The house may have one unlighted sign no larger than one square foot in area to advertise that rooms are for rent.

• • •

Cities set up rules for granting employe-leaves

Faced with losing many of their employes to high-paying war jobs, in addition to those entering military service, cities are adopting strict regulations on leaves of absence, according to the Civil Service Assembly.

Most cities are granting applications for leave to go into civilian jobs connected with the war only when the employe has some special skill needed in war work, when his position can be filled easily by a temporary appointment, or when it can be left vacant because of curtailed municipal services. Those requesting leave for military service are receiving it without question.

In the city of Los Angeles, which is having difficulty securing temporary employes competent to fill the many vacancies occurring, the civil service commission has adopted the following procedure:

Employes requesting leave must show they have been solicited by a vital war agency because they are outstanding technicians such as could not readily be procured elsewhere; or they must be performing work for the city that is likely to be curtailed at an early date. Individuals accepting civilian positions with the armed forces as a prelude to entering service also are given leaves.

The Detroit Civil Service Commission requires a department head to certify his belief that the employe is

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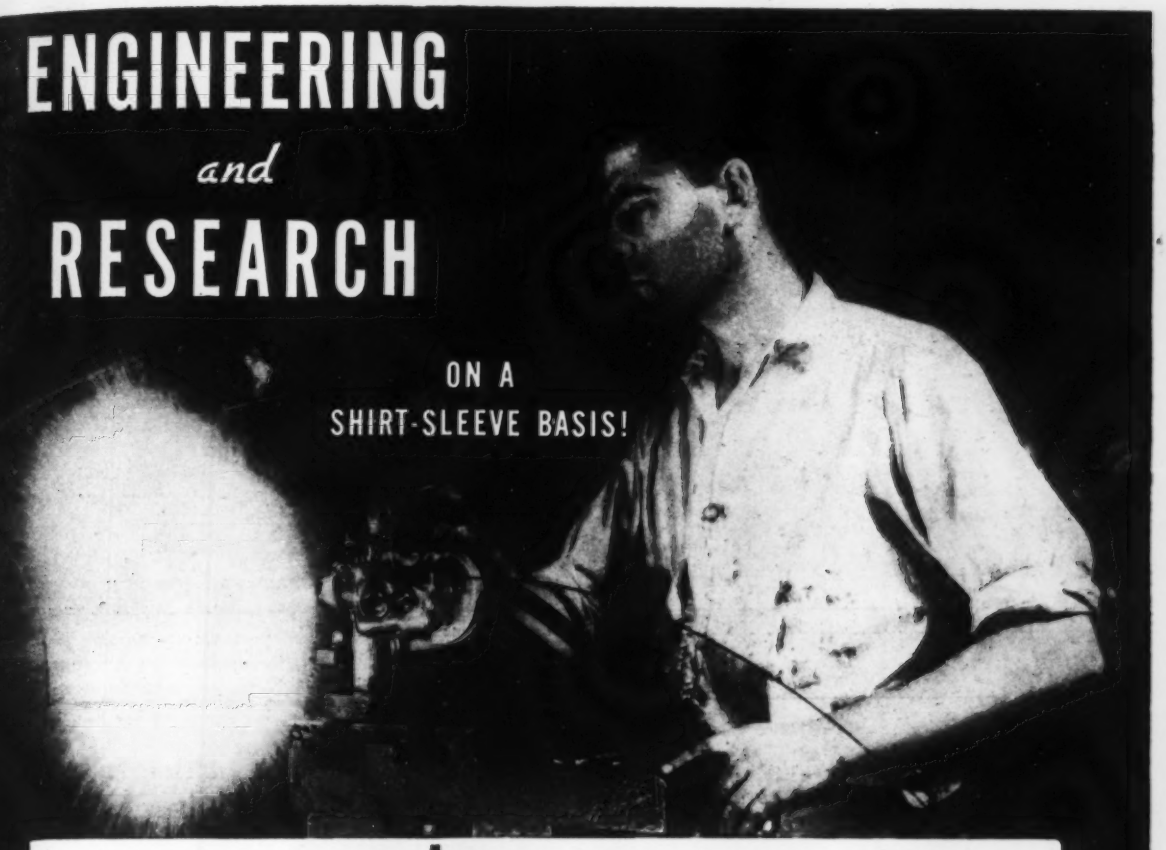

If your organization is jammed-up with war-work . . . or if you are short of technicians . . . let us take over your engineering and research problems. No "frock-coat" conferences . . . no doodad tinkering . . . but real, honest, sweaty work on a shirt-sleeve basis. Round-the-clock service! We are equipped and staffed for the following phases of engineering:

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- ★ *Efficiency, calibration tests on gas and electrical appliances, refrigeration and air conditioning units.*
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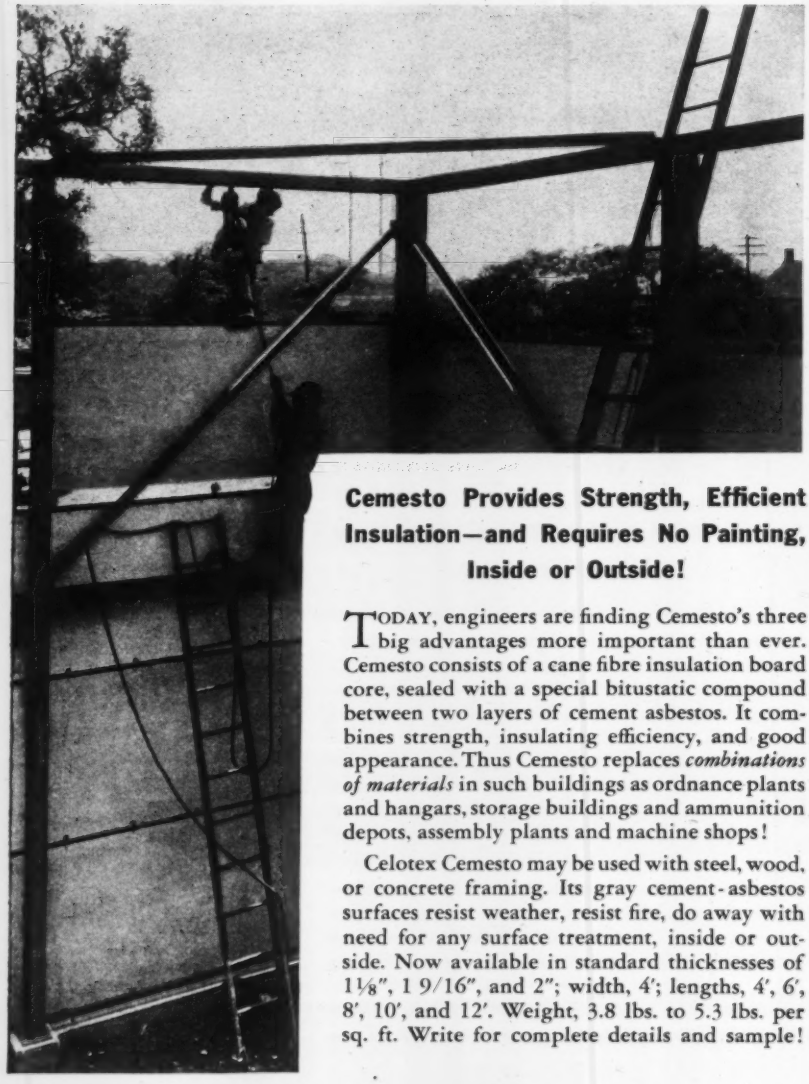

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Celotex Cemesto may be used with steel, wood, or concrete framing. Its gray cement-asbestos surfaces resist weather, resist fire, do away with need for any surface treatment, inside or outside. Now available in standard thicknesses of 1⅛", 1 9/16", and 2"; width, 4'; lengths, 4', 6', 8', 10', and 12'. Weight, 3.8 lbs. to 5.3 lbs. per sq. ft. Write for complete details and sample!

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"more essential to public necessity in his proposed position than in his present city position," and that it will either be unnecessary to fill his job for the duration of the war, or that equally well-qualified persons are available to take his place.

The proposed employer, in turn, must certify that the employe is essential in his proposed position, and that failure to secure his services will delay or inconvenience war production.

In New York City, the recommendation has been made to department heads that they grant leave only in instances where the employe will not be a serious loss to essential city services, or where his position can be filled temporarily, or can be left vacant.

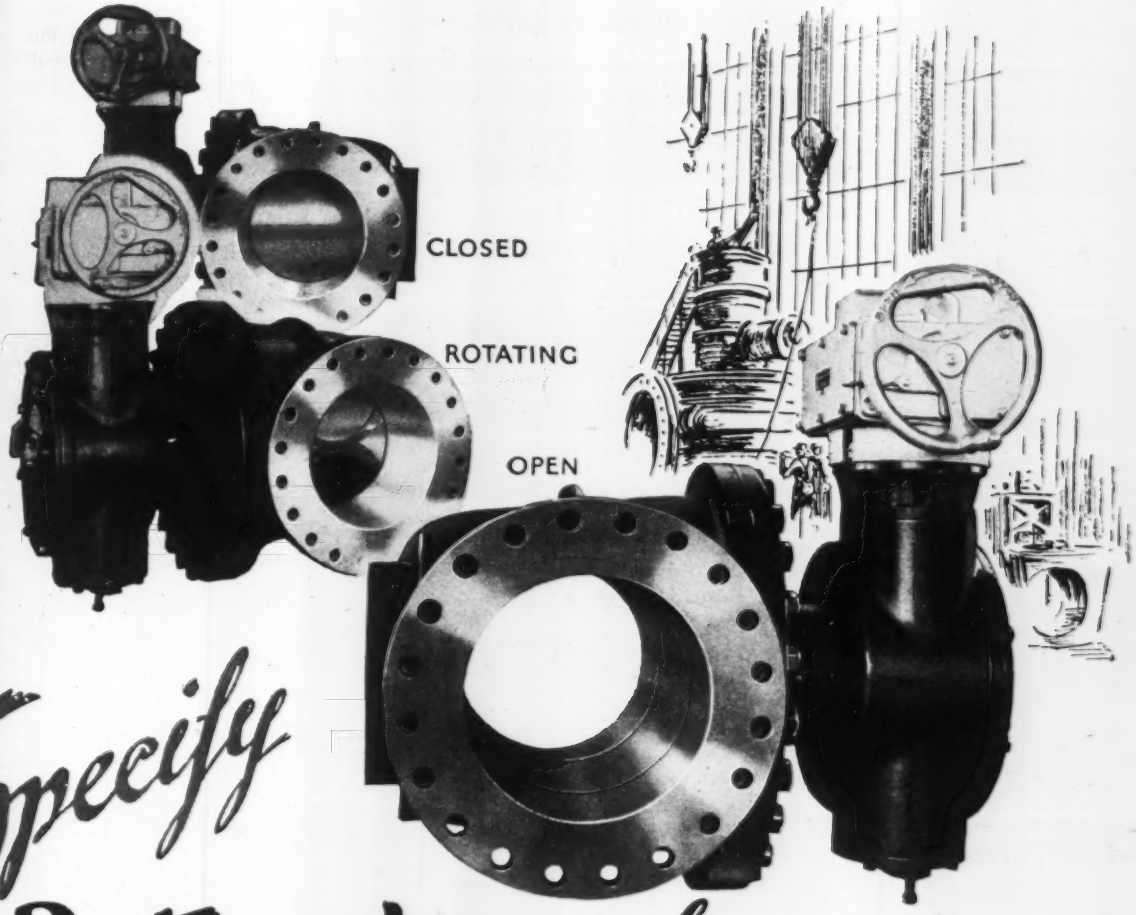
New Jersey's state civil service commission is granting state employes leaves to enter war industries for periods up to one year only, if their services can be spared.

• • •

Empty city lots useful in war housing

Two proposals for war housing seem to be more practical now than at any previous time, the National Association of Real Estate Boards declares in a letter to John B. Blandford, administrator of the National Housing Agency. The Association suggests that government building might well be in great part temporary houses erected on scattered vacant lots, in cities where that is feasible, along the line worked out by the Portland, Ore., Housing Authority. This housing could be put under way quickly, and the use of the lots could be obtained substantially for the amount of the annual taxes, the association believes.

Employing temporary construction that has a high salvage value, Portland, under its "Gartrell Plan," has 725 dwelling units either completed, under construction or contracted for at a cost running about $1,500 less than the usual housing project for which land must be purchased. Schedule time for building the Gartrell-plan house is thirty-three calendar days. The two-bedroom houses have been built for an average cost of about $2,375 a unit. Partly prefabricated units and units completely constructed on the ground have both been used. Salvage value for mate-



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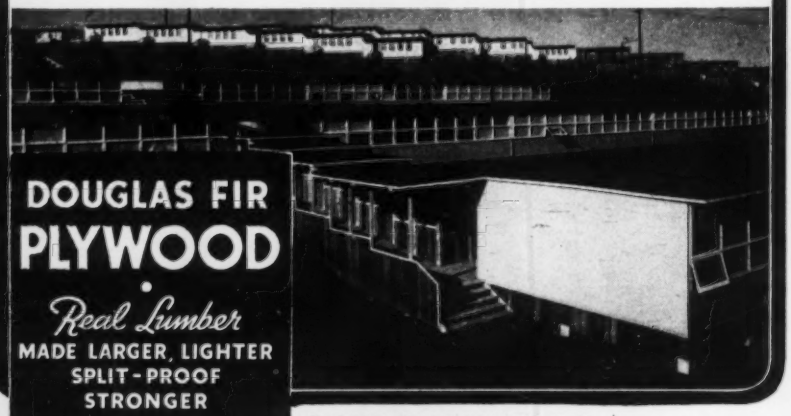
● Douglas Fir Plywood is the principal structural material in hundreds of thousands of hutments, barracks, dormitories, housing projects and shelters of every type. Part of these have been prefabricated, and part have been constructed by traditional on-the-job methods. But wherever Douglas Fir Plywood has been used, its large sizes, light weight, great strength, split-proofness, easy workability and other advantages have saved time and labor while building warmer, more rigid, more durable structures. To help speed Victory, the Douglas Fir Plywood Industry is devoting its entire capacity to war production. Athough *you* may not be able to buy this *miracle wood* now, learn everything you can about it. After Victory, it may be able to serve you as efficiently as it is serving the war effort today. Write for free Industrial Handbook, also prefabrication data or technical assistance. Douglas Fir Plywood Assn., 1686 Tacoma Bldg., Tacoma, Wash.



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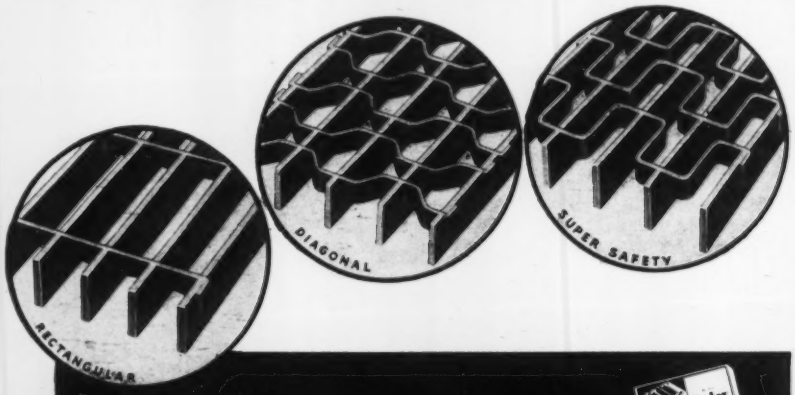

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rials after five years' use is estimated at not less than $200.

Backed by the Portland Realty Board, the plan, proposed by C. M. Gartrell, chairman of the Portland Housing Authority, is using for those war workers' homes that must be publicly built, some of the several thousand lots, title to which has reverted to the city or the county, lots fully provided with utilities.

Following a check made with real estate boards of leading cities where housing is an acute need, the association further suggests that conversion of old large houses, while often not economical for private enterprise, could nevertheless give adequate war housing quickly if suitable action were taken by the government to remodel big old, but sound, structures in reasonably good locations. Such conversion would entail small use of critical materials.

• • •

"Priorities Chief" handles city war orders

When it comes to buying new supplies and materials for governmental offices, Louisville and Jefferson county, Ky., are taking the attitude of "how many things can we get along without?"

Through a "priorities chief," the city and county clear all orders and priority forms on supplies and equipment. With the chief is working a committee made up of Louisville's director of public works, the mayor's administrative assistant, and the purchasing agent of Jefferson county. These men approve or disapprove every request, sifting out all applications for materials and supplies they feel are not absolutely necessary.

Before setting up the procedure, Louisville's priorities chief studied a similar plan in effect in New York City's centralized purchasing division, according to the American Municipal Association, and spent a week in Washington interviewing various department chiefs of the WPB priorities division.

Construction of a 24-in. oil pipeline from east Texas oil fields to Norris City, Ill. (*ENR*, July 16, p. 76) recently hit a record pace of 8.15 miles completed in one day. Pipeline construction for the past several weeks has averaged about 6 mi. daily.

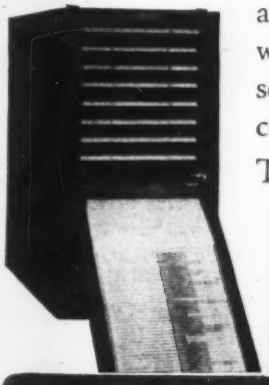
Expedite: to hasten movement or progress of, especially by removing impediments; to facilitate; to accelerate.

● Record-keeping will never *build* a ship. But records can—and do—expedite production. Particularly Kardex records.

Take the case of a Kardex Procurement record.

When you buy an item of production material, your copy of the purchase order says, in effect, "We bought X items today from Y Company, and have been *promised* delivery in Z days." The average procurement procedure stops right there. If there's a delay in delivery, and production's slowed, you can blame the vendor who failed his promise.

But where the "average record" *stops* its job, a Kardex System *begins.* For Kardex is a *signalled* record. On a Kardex Procurement Record, these signals say, at a glance, "Here's the promised date of delivery, and HERE'S the date where you'd better begin your follow-up procedure, because HERE we see that there are only 2 weeks supply on hand." And it says all this with colored signals that can be read at a single glance!



That's a production expediter—a Kardexed record that tells you, without your digging for facts, just *when* and *how hard* you must press for delivery. And Kardex signalled records have been adapted for every production problem—from purchasing to personnel, from Machine-load to materials. Kardex doesn't *build* ships—but it *expedites* their production.

Another Kardex Production "Expediter"

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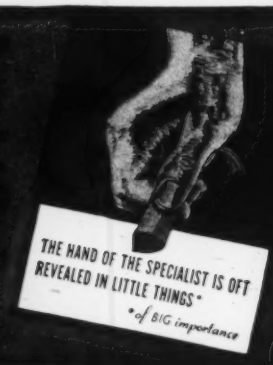
THIS CONFIDENCE MUST BE MAINTAINED

Just because bombers, pursuit ships, tanks or PT boats do not roll from our assembly lines, let's not forget that production schedules for those fighting craft would be thrown "all out of whack" if Continental rubber parts did not come through on time.

Fortunately, we of Continental have specialized in meeting sudden and unusual requirements for so many years that we are meeting these war demands with exceptional promptness and accuracy. These crucial war industries have the same confidence in us which civilian users of industrial rubber goods have had in the years gone by—a confidence that is up to us to maintain.....at all costs.



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Cut Quebec paper mills' power

Curtailment of production of nine newsprint mills in Quebec Province to release 50,000 horsepower for war industries has been announced, following conferences between officials of the Wartime Prices and Trade Board, National Selective Service and Power Controller H. J. Symington.

The mills affected by the curtailment order are: The Beauport mill of Abitibi Power and Paper Company, Limited; the Grand'Mere, Shawinigan Falls and Three Rivers mills of Consolidated Paper Corporation, Limited; the Quebec mill of Anglo-Canadian Pulp and Paper Mills, Limited; the Donnacona Paper Company, Limited, mill at Donnacona; the Donohue Brothers mill at La Malbaie; the Three Rivers mill of the St. Lawrence Paper Mills Company; and the Three Rivers mill of Canadian International Paper Company.

The announcement did not state the percentage reduction at the mills concerned, nor did it say exactly what provision had been made to fill orders affected by the curtailment, except that they would be "transferred to other mills from which power is not required for war industries." This is similar to the provision made when the output of Ontario Paper Company mill at Thorold, Ont., was curtailed.

The announcement made it evident that manpower considerations ranked with the saving in power in making the curtailment. The wording of the announcement that "part of the manpower" of the mills would be released for war industry indicated that the curtailment would take the form of the shutting down of some machines in each mill rather than in stopping the mills for part of each week.

It did not say, however, how many men would be diverted to other industries by the move, mentioning specifically only the 50,000 horsepower saving.

The announcement quoted Newsprint Controller R. L. Weldon as saying that any further reductions will be made as soon as the requirements of the war plants are more accurately known. Mr. Weldon estimated that future power curtailments would be similar in size to the one announced at this time.

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We'd like to show you this picture — but wartime restrictions don't permit it. It's one of many showing construction and erection jobs handled by Graver.

But the most important part of the job doesn't show in the picture. It's the experience that lies back of it — the knowledge and ability which are responsible for our success in this highly specialized field.

Graver offers to the oil, steel, rubber, and process industries a complete construction and erection service capable of handling any job, large or small. And Graver has the knowledge, experience, equipment, and trained personnel to handle the work efficiently and economically.

While this service does not include engineering or designing, it does provide for complete erection together with the fabrication, by our manufacturing division, of such equipment as may be desired.

Write for further details about this service.

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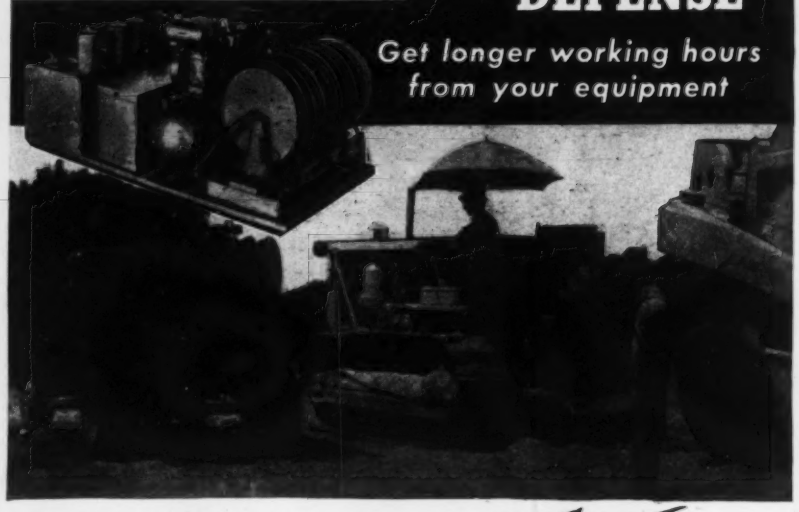

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¾" long thread, each end ¼" diam. U. S.—20 thread 6,000 lbs. Ultimate Tensile 4,800 lbs. Working Load per Rod			⅞" long thread, each end ⅜" diam. U. S.—16 thread 9,500 lbs. Ultimate Tensile 7,500 lbs. Working Load per Rod			1¼" long thread, each end ½" diam. U. S.—13 thread 16,500 lbs. Ultimate Tensile 13,000 lbs. Working Load per Rod		
LENGTH of Rod	Price per 100 Rods	App. Wall Width	LENGTH of Rod	Price per 100 Rods	App. Wall Width	LENGTH of Rod	Price per 100 Rods	App. Wall Width
12" or less	$2.00	15" or less	12" or less	$3.00*	15" or less	12" or less	$4.00*	15" or less
13"	2.17	16"	13"	3.25	16"	13"	4.33	16"
14"	2.33	17"	14"	3.50	17"	14"	4.67	17"
15"	2.50	18"	15"	3.75	18"	15"	5.00	18"
16"	2.67	19"	16"	4.00	19"	16"	5.43	19"
17"	2.83	20"	17"	4.25	20"	17"	5.67	20"
18"	3.00	21"	18"	4.50	21"	18"	6.00	21"
19"	3.17	22"	19"	4.75	22"	19"	6.33	22"
20"	3.33	23"	20"	5.00	23"	20"	6.67	23"
21"	3.50	24"	21"	5.25	24"	21"	7.00	24"
22"	3.67	25"	22"	5.50	25"	22"	7.33	25"
23"	3.83	26"	23"	5.75	26"	23"	7.67	26"
24"	4.00	27"	24"	6.00	27"	24"	8.00	27"
Price per add'l inch $.0015		Figure rods from 2" to 5" less than Wall for Vibra-Lock or nearest 3" multiple	Price per add'l inch $.0023		Figure rods from 2" to 5" less than Wall for Vibra-Lock or nearest 3" multiple	Price per add'l inch $.0031		Figure rods from 2" to 5" less than Wall for Vibra-Lock or nearest 3" multiple
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Lengths over 20'0" add for Williams High Tensile Couplings per 100 $2.75			Lengths over 20'0" add for Williams High Tensile Couplings per 100 $3.75			Lengths over 20'0" add for Williams High Tensile Couplings per 100 $4.75		

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The curtailment was in addition to readjustments already made in a number of Quebec mills, wherein each mill is shutting down one day out of seven on staggered days rather than all on Sunday, so as to spread the power load more evenly over every day of the week. An estimated 40,000 horsepower has been saved by the staggering.

• • •

Scientific painting for more light and safety

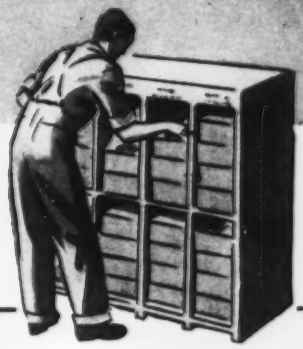
As a result of extensive research by its paint technicians and illuminating engineers, E. I. du Pont de Nemours & Co., Wilmington, Del., offers a solution to the problem of speeding production through a new and scientific method of using color and light in the right combination.

Known as "three-dimensional seeing", this new science satisfies the two basic requirements—brightness and contrast—which make strainless full vision possible. By painting machinery in colors having high light-reflection qualities, machines become light reflectors instead of light robbers. By applying the same theory to ceilings, walls and floors, the efficiency of the lighting system is greatly increased.

In so far as machinery is concerned, better seeing conditions are provided because the usable light at the immediate working point is increased. The tests indicated clearly that light gray was the most desirable color for the bodies of machinery when combined with a suitable contrasting hue, such as buff, for the operating parts of "danger points". The soft contrasts created by such a combination were easier on the eye than abrupt changes in brightness. Also both colors stood high in reflective qualities. Two paints were developed by du Pont to fill the indicated need, and were appropriately named Spotlight Buff and Horizon Gray.

As to painting of interior surfaces, tests indicated, when all of the reflecting surfaces and particularly the floors were painted, that the reflection factor was increased from 27 to 70 percent, and the coefficient of light utilization was improved more than 100 percent over the unpainted surfaces. In these tests the ceiling was painted in a light tone of cream, the side walls with a neutral green,

"Store welding electrodes in a dry place— they will keep indefinitely if properly cared for"



Always keep electrodes in a dry place — on a clean shelf or rack, or at least off the floor. Don't expose them to moisture, keep them away from sweating pipes and open windows. If by accident a box of electrodes should get wet, spread them out to dry immediately.

Follow these simple precautions together with those enumerated at the right — fight waste to speed victory.

A booklet of shop bulletins illustrating "do's" and "dont's" has been prepared to help your welding operators get the most out of every electrode. We'll gladly send you as many copies as you can use.

WELDING ELECTRODES ARE SCARCE
Help Prevent Waste

- Do not bend electrodes unless absolutely necessary
- Use electrodes down to a 2-inch stub
- Fit joints properly before welding
- Make legs of fillet welds equal
- Make the face of fillet welds flat

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You can speed war-time foundation jobs and help save vital steel by using ARMCO Spiral Welded Piles.

These sturdy piles make for straight driving with the least time and effort. The tough spiral weld imparts great beam strength to even the longest lengths. Yet ARMCO Piles are light in weight for quick, easy handling and hauling. Long lengths also save driving time. Order ARMCO Piles in any length (not random) that can be handled and shipped.

For utmost metal economy specify the exact weight you need in any diameter to fit the job. Diameters range from 6 to 36 inches; wall thicknesses from 3/16 to 1/2 inch. Uniform diameters permit full salvage of cut-off pieces. When required, end-plates and cone-points can be attached at the pipe mill.

If you are planning essential war construction work write or wire us for quotations and shipping promises on ARMCO Spiral Welded Foundation Piles. The American Rolling Mill Co., Pipe Sales Div., 2941 Curtis St., Middletown, Ohio.

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and the floor with white [illegible]k paint stippled with spruce br[illegible] Light-colored furniture was also [illegible]ed.

In order to aid in the s[illegible]tion of colors, du Pont maintena[illegible]e engineers are equipped with an [illegible]genious color selector, by means [illegible] which suitable colors can be chos[illegible] for any industrial area, both for m[illegible]chinery and working surroundings. While the number of combinations sh[illegible]n is by no means exhaustive, the [illegible]nge of color schemes is sufficiently v[illegible]ried to provide appropriate and suit[illegible]le colors for any industrial interior.

• • •

Emergency alternate Federal specifications

In an effort to aid in the conservation of strategic war materials, the Consumer Standards Section, of the U. S. Department of Agriculture, at the request of the Specifications Branch, Conservation Division, War Production Board, is making a comparative analysis of emergency alternate Federal specifications. To facilitate such an analysis, a *Directory of Emergency Alternate Federal Specifications*, issued from April 29, 1941 to June 10, 1942, has been compiled. This Directory classifies all the specifications issued during this period into the same commodity groups established for Federal Specifications. It also furnishes ready reference in numerical order of issuance, and gives the symbol and date of issuance or revision. Furthermore it contains a comprehensive index by specific commodities.

Copies of the comparative analysis of the various specification groups may be obtained by writing to C. L. Warwick, Chief, Specifications Branch, Conservation Division of the War Production Board at Washington, D. C.

• • •

Hardware manual used for Government building

Maximum specifications for builders' hardware, such as locks, door closers, knobs, hinges, and brackets, to be installed in construction projects of the Army and Navy, Maritime Commission, the Reconstruction Finance Corporation, Public Buildings Administration, and National Hous-

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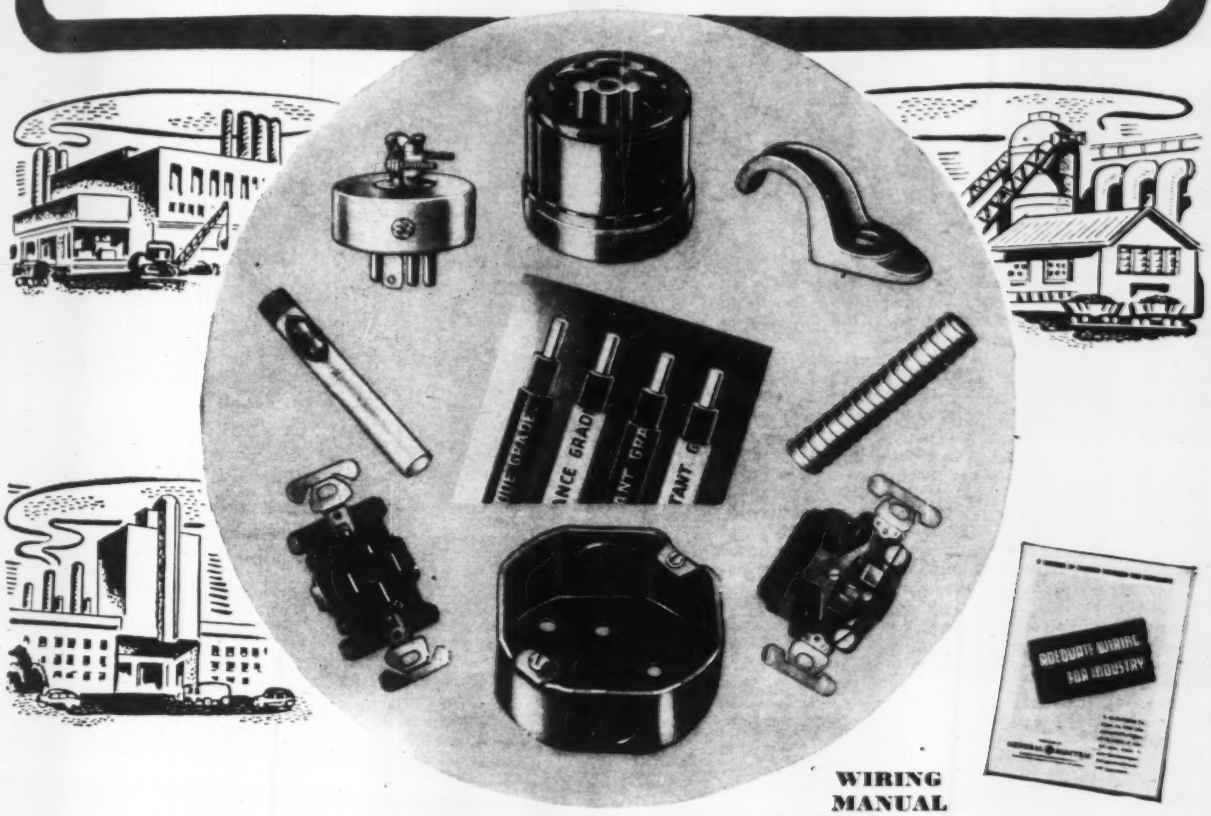

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YOU'LL find exactly the right wiring materials for new wiring systems, for modernization work, and for maintenance in the G-E line. These materials are conveniently available in your territory, too. G-E Merchandise Distributors are located at all key points in the country.

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General Electric has prepared a manual called "Adequate Wiring for Industry" which describes modern wiring methods and materials. You'll find it helpful in checking and planning industrial wiring. The manual interprets wiring in terms of savings and service.

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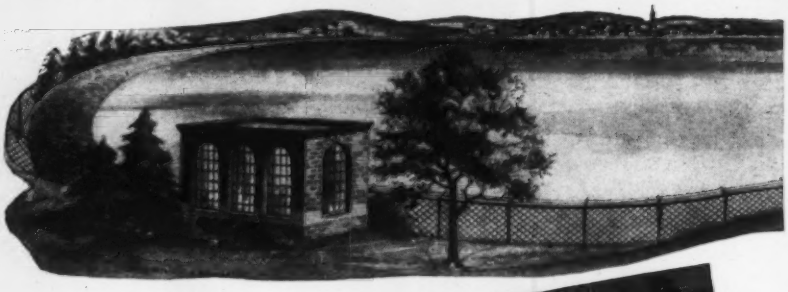


The future won't be an easy one for water plant operators. Further population shifts may mean increased demands and pollution of the supply sources. Industrial pollution of streams and rivers may also increase.

Yet you will be expected to maintain safe water in spite of natural or man-made emergencies, and to do it with limited manpower and restricted delivery of equipment and supplies.

One good way to get set for whatever may come is to make a complete CHLORINATION check-up right now. You'll want to make sure that your plant Chlorinators are in perfect working order, giving close control over the wide range of application rates that coming conditions may require. Possibly you'll want to rearrange connections so as to get more service out of stand-by units, or to give more flexibility to points of chlorine application.

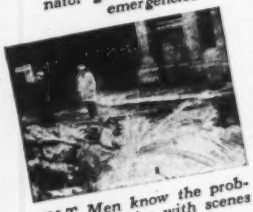
Then, future emergencies must be considered, and provision made for treating temporary sources, for sterilizing repaired mains, and for secondary chlorination whenever the distribution system may require it.

Your local Wallace & Tiernan Representative is anxious *to help you make the best possible use of your present equipment,* supplementing it with new facilities only where public health requires it. If you call him now, he'll have a chance to go over your equipment and discuss your problems before a critical situation arises, and can arrange his trip so as to save on transportation.

SA-140

Plan now for a check-up of your Chlorination equipment

This W&T Portable Chlorinator gives extra safety in emergencies



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ing Agency, are given in a *Builders' Hardware Manual* just issued by the Division of Industry Operations, War Production Board. The *Manual* is made effective through a WPB memorandum which directs that priorities issued for construction of war housing and for other Government building costing more than $50,000 are to be limited to materials included in the *Manual*. It is also provided in Directive No. 5, issued by the War Production Board, that the Army, Navy, and Maritime Commission shall consider the *Manual* as providing maximum equipment in all contracts.

• • •

Definitions of building terms published

The United States Department of Commerce and the National Bureau of Standards have just made available to the public a *"Glossary of Housing Terms"*, in an attempt to bring together for the convenience of all concerned the definitions of many generally accepted terms used in housing and building literature.

The glossary is a revision of a similar publication first issued in 1937, and was compiled by a committee from the five federal agencies principally concerned with housing. Work of revision and expansion began in 1940.

Copies of the booklet are available at the office of the Superintendent of Documents, Government Printing Office, Washington, D. C.

With the thought that a partial list of some of the definitions included may be of value to engineers and contractors, *Engineering News-Record* presents those below:

construction types:

—***adobe construction.***—A type of construction in which the exterior walls are built of blocks that are made of soil mixed with straw and hardened in the sun. This type of construction is employed chiefly in the warm, dry climate of the Southwest.

—***brick construction.***—A type of construction in which the exterior walls are bearing walls made of brick or a combination of brick and tile masonry.

—***brick-veneer construction.***—A type of construction in which a wood-frame construction has an

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G-A VALVES

SAFETY—Because each valve that G-A makes is designed and built with life and property protection as one of its main features . . . because each part of every G-A valve is made of the best materials and tested for strains far beyond rated operating capacity.

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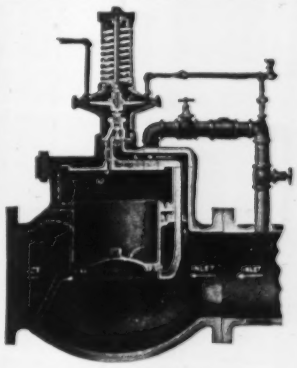
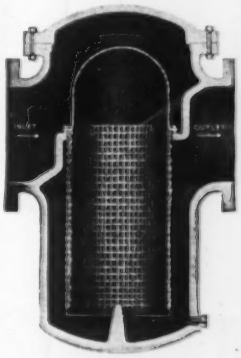
Numerous users of GOLDEN-ANDERSON Valves are finding the G-A valve maintenance and service data extremely valuable . . . how about you? Regardless of the type of G-A valves you may operate, you must be prepared to meet emergencies, remote as they may seem . . . today is no time to risk breakdowns and service delays on vital lines and tanks. Write for this helpful material at once.



ALTITUDE CONTROL VALVE

Maintains water levels within 3 to 12 in. variation. Differential control permits delayed valve opening for any depth tank. May be fitted for electric control or remote operations. Single or double acting. 2 to 36 in. sizes.



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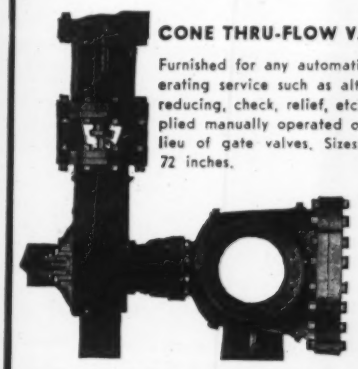
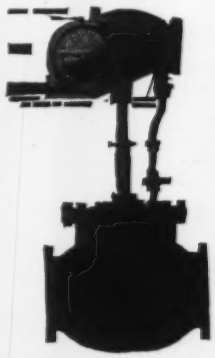
Comes with large capacity basket of suitable mesh to meet all service demands. Readily cleaned. Sizes 3 to 36 inches.



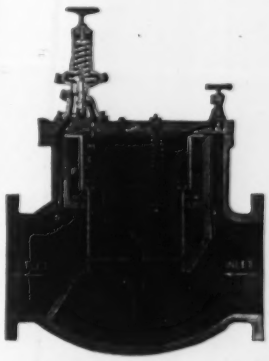
CONE THRU-FLOW VALVE

Furnished for any automatic operating service such as altitude, reducing, check, relief, etc. Supplied manually operated only in lieu of gate valves. Sizes 4 to 72 inches.



CONTROLLED FLOAT VALVE

Maintains water level within 1" variation. Suitable for closed or open tanks, etc. Furnished without self contained float ball chamber, if desired. Air and water cushioned.



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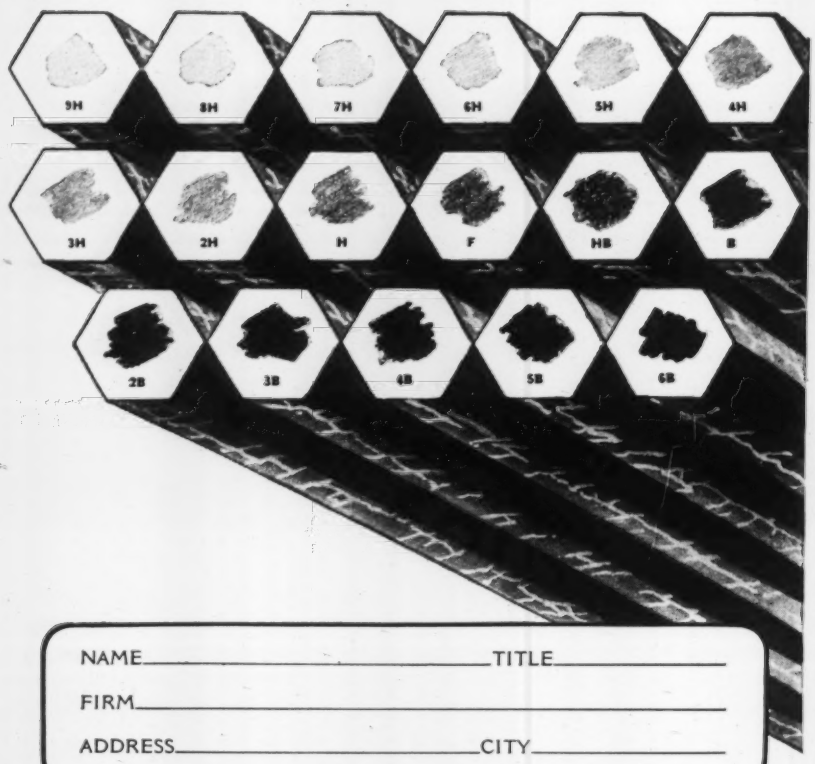

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exterior surface of b[illegible] applied.

—***dry-wall construction.***—A type of construction in wh[illegible] the interior wall finish is of [illegible] material other than plaster or [illegible] material similar to it.

—***exterior - protected construction.***—That type of building construction in which the exterior walls, party walls, and fire walls are of incombustible materials and self-supporting, and interior structural framing is wholly or partly of wood or similar materials.

—***fireproof construction.***—A type of construction designed to withstand a complete burn-out of the contents for which the structure was intended without impairment of structural integrity. Use of incombustible materials, and certain fire-resistance requirements for structural members, including exterior walls, is customarily stated in codes.

—***incombustible construction.***—That type of building construction which has all structural elements of incombustible materials with fire-resistance ratings of 1 hour or less.

—***ordinary construction.***—A type of construction in which the exterior walls are of masonry, or of reinforced concrete; and in which the interior structural elements are wholly or partly of wood.

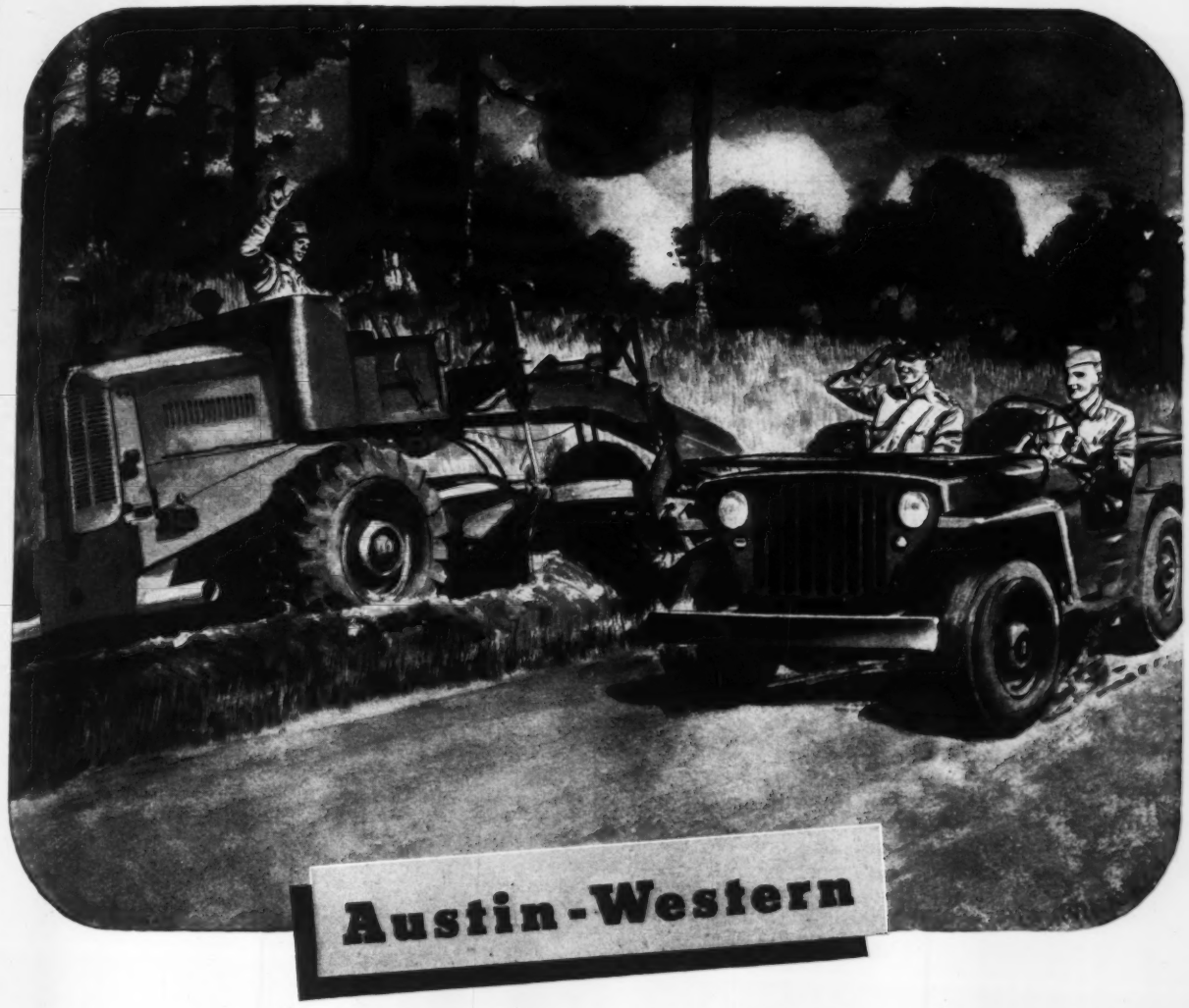
—***prefabricated construction.***—A type of construction so designed as to involve a minimum of assembly at the site, usually comprising a series of large units manufactured in a plant.

—***rammed-earth construction.***—A type of construction in which the exterior walls are bearing walls composed of a controlled combination of sand, clay, coarse aggregate, and moisture compacted by pressure into forms.

—***reinforced - concrete construction.***—A type of construction in which the principal structural members, such as floors, columns, and beams, are made of concrete poured around isolated steel bars or steel meshwork in such manner that the two materials act together in resisting force.

—***skeleton construction.***—A type of construction in which all external and internal loads and stresses are transmitted to the foundations by a rigidly connected framework

EVERY ROAD LEADS TO VICTORY



● There are no *unimportant* roads in America today! Unless food products move over "secondary" farm-to-market roads with dispatch and unfailing regularity . . . unless raw materials and finished parts get to far-flung processing, fabricating and assembling plants on schedule . . . the vital high-speed timetables of our armed forces and armament builders can't be maintained.

Since war needs make it impossible for you men who must build and maintain America's roads to get much new equipment, it's mighty important to keep available machines in the pink of condition.

This calls for instructions to operators on avoidance of abuse, overloading and excessive speeds. Even ruggedly built A-W machines have endurance limits. And regular inspection and maintenance by men who know exactly what to do, means extra years of effective performance . . . will help you keep irreplaceable equipment operating for the duration.

Your nearby Austin-Western dealer has this experience. He is trained and equipped to do a thorough job with a minimum of lay-up time for the machines. Use his expert service for all major maintenance and repair jobs. He will gladly help you work out a practical system of operator instruction, of inspection, lubrication and adjustment that will prevent many breakdowns . . . help you make good on your vital assignment of keeping 'em rolling on the home front.

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Metal sheeting is a military *must* on many important war projects. Yet you want to be sure you are making the best possible use of it because steel is precious. So consider the economics of ARMCO Steel Sheeting.

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You can save even more time and metal by ordering ARMCO Sheeting in the exact gage and type you need. Interlocking, flange and clip-types are supplied in 8, 10 and 12 gage, in 12 and 14-inch widths, and in standard lengths up to 18 feet. Lengthwise corrugations provide ample strength, also make the sheeting nestable, simplifying storage and shipping problems. When you order ARMCO Sheeting, you can call on ARMCO engineers for help in solving unusual and difficult applications. Write or wire for quotations. Armco Drainage Products Association, 1055 Curtis Street, Middletown, Ohio.

* * ARMCO * *

ARMCO SHEETING

of metal or reinforced concrete. The enclosing walls are supported by the frame at designated intervals; usually at each story.

—***steel-frame construction.*** — A type of construction in which the structural parts are of steel or dependent on a steel frame for support.

—***unprotected - metal construction.***—A type of construction in which the structural parts are of metal unprotected by fireproofing.

—***wood-frame or frame construction.***—A type of construction in which the structural parts are of wood or dependent on a wood frame for support. In codes, if brick or other incombustible material is applied to exterior walls, the classification of this type of construction is usually unchanged.

roof types:

—***curb (or curbed) roof.***—A roof in which the slope is broken on two or more sides; so called because a horizontal curb is built at the plane where the slope changes.

—***flat roof.***—A roof which is flat or one which is pitched only enough to provide for drainage. (*Compare* ROOF TYPES: PITCHED ROOF.)

—***gabled roof.***—A ridge roof which terminates in a gable.

—***gambrel roof.***—A gable roof each slope of which is broken into two planes.

—***hip (or hipped) roof:***

1. In general, a roof which has one or more hips.
2. A roof which has four sloping sides that meet at four hips, or at four hips and a ridge.

—***lean-to roof:***

1. A roof which has a single sloping surface that is supported at the top by a wall that is higher than the roof.
2. A roof which has a single sloping surface.

—***mansard roof.***—A type of curb roof in which the pitch of the upper portion of a sloping side is slight and that of the lower portion steep. The lower portion is usually interrupted by dormer windows.

—***monitor roof.***—A type of gable roof commonly used on industrial buildings, which has a raised portion along the ridge with openings

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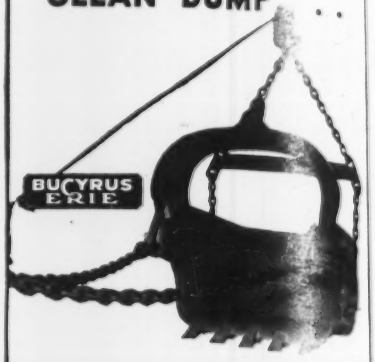
CLEAN DUMP . . .



That's why RED ARCH Buckets will give you faster dragline operation, bigger output to meet wartime demands. These modern buckets add to your production because they are:

1. Scientifically designed on the basis of 62 years' experience. 2. Manufactured from tough, light special alloy-steels. 3. Fitted with famous Beco Tiger Teeth—easily replaceable, reversible and renewable. 4. Equipped with the new, strong, butt welded Red Arch chain.

Capacities from ⅜ to 14-yards: light, medium and heavy duty types. Step up your output with Red Arch Buckets!

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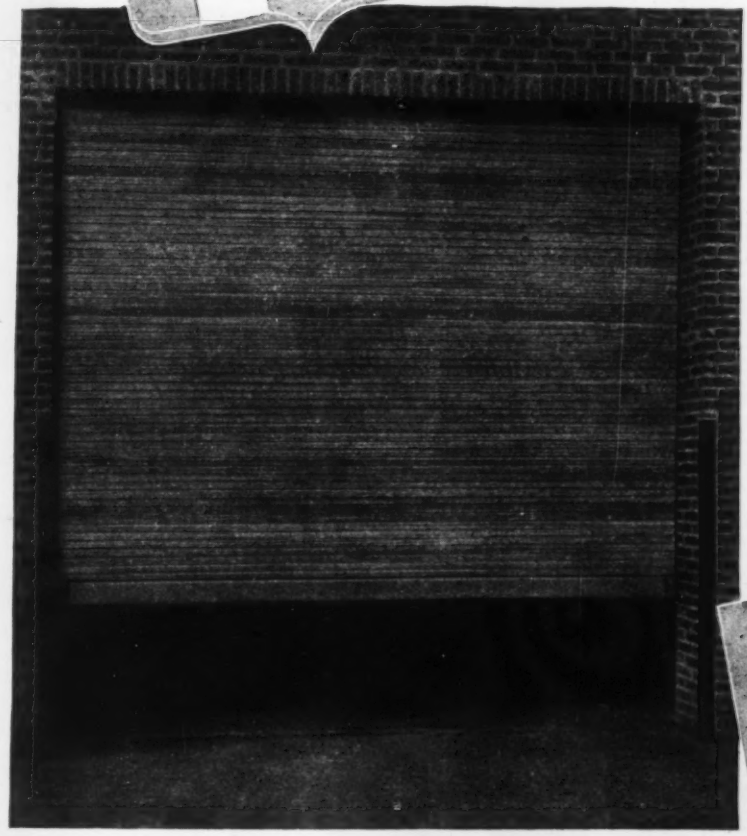
Kinnear *Wood* Rolling Doors

FAMOUS STEEL ROLLING DOOR MAKER SOLVES WARTIME DOOR PROBLEMS

Kinnear Wood Rolling Doors have been widely used for numerous special door requirements for many years. And now they are meeting today's demand for time-and-space-saving doors that minimize the use of critical materials.

They feature the efficient coiling upward action perfected in the famous interlocking steel slat door which Kinnear *originated* nearly half a century ago!

Constructed of inter-lapped wood slats jointed with metal cables or tapes, these sturdy Wood Rolling Doors travel upward in special jamb guides and coil above the opening. As convenient in action as a window shade, they open out of the way and out of reach of damage, requiring no usable floor, wall, or ceiling space for either storage or operation.



Their rugged, closely-assembled wood-slat curtain blocks out wind and weather, and affords a remarkably high degree of protection against intruders and saboteurs. Only carefully selected, specially treated woods are used, assuring maximum wear and resistance to the elements at lowest possible maintenance costs.

To meet all door needs in face of wartime contingencies *without* sacrificing performance and service, install Kinnear Wood Rolling Doors.

Kinnear Wood Rolling Doors are available in any size, for installation in old or new buildings. Motor, manual, or mechanical operation.

***Write Today* FOR BULLETIN 37**

Gives complete specifications and shows how the wood slat curtain is assembled for strength, weather protection and smooth coiling action.

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BUCYRUS . . . OHIO

for light and/or air.

—***pent roof.***—A roof, other than a lean-to roof, which has a single sloping surface.

—***pitched roof.***—A roof which has one or more sloping surfaces pitched at angles greater than necessary for drainage. (*Compare* ROOF TYPES: FLAT ROOF.)

—***pyramid roof.***—A hip roof which has four sloping surfaces, usually of equal pitch, that meet at a point.

—***ridge roof.***—A roof which has one or more ridges.

—***roof valley.***—The sloping line at the junction of two roof surfaces where an external angle less than 180 degrees is formed.

—***roofing.***—The materials applied to the structural parts of a roof to make it watertight.

walls:

—***bearing wall.***—A wall which supports any vertical load in addition to its own weight.

—***common wall.***—A wall owned by one party but jointly used by two parties, one or both of whom is entitled to such use under the provisions of a lease.

—***curtain wall.***—A nonbearing wall between columns or piers which is not supported by girders or beams.

—***dry wall.***—A wall of stone or other durable material, laid without mortar.

—***enclosure wall.*** — An exterior nonbearing wall in skeleton construction anchored to columns, piers, or floors, but not necessarily built between columns or piers.

—***exterior wall.***—Any outside wall or vertical enclosure of a building other than a party or common wall.

—***faced wall.***—A masonry wall faced on one or both sides with a material different from the body of the wall, in which the facing and the body are bonded so that they will act as a unit under loads.

—***fire wall.***—A wall which subdivides a building to restrict the spread of fire. It starts at the foundation and extends continuously through all stories to and above the roof.

—***fire-division wall.***—A wall which subdivides a building to restrict the spread of fire, but is not necessarily continuous through all stories nor extended through the roof.

—***foundation wall.***—Any bearing

All Kinds of Saboteurs Can't Be Stopped At the Gates

Fences and guards won't keep out accidents — as much to be guarded against as enemy agents

IN terms of crippling damage, on-the-job accidents are just as sinister as the human saboteur. Whenever precautions against them are relaxed, they are likely to strike suddenly and viciously, injuring and killing men, damaging equipment, wasting irreplaceable material, upsetting schedules.

To you, as a contractor faced with fast schedules and lack of trained manpower, the prevention of sabotage caused by accidents has become a "must". To help you achieve it most surely, American Mutual offers a safety engineering service perhaps unexcelled.

Always a leader in the safety movement, this Company aids its contractor-policyholders through safety consultants especially trained and experienced in construction work. These specialists set up and follow through proper controls. They give you every assistance in establishing safe operating conditions and practices and in forestalling accidents. With much war-time experience already behind them, they can undoubtedly save *you* worries, as well as serious losses.*

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* Much accident prevention depends upon *foremen*, who may themselves be new to your particular set-up. Have us send you a free copy of "Foremanship", containing valuable information on hiring and training new foremen, and "refresher" material for experienced foremen. American Mutual Liability Insurance Company, Dept. O10, 142 Berkeley Street, Boston, Mass.

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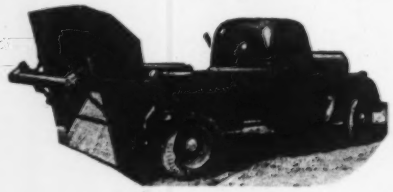

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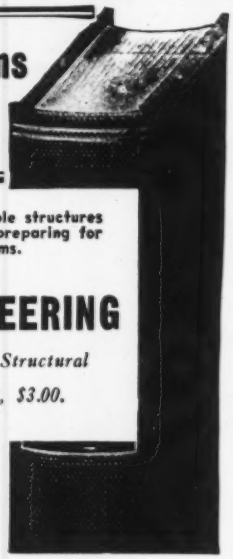

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wall or pier below the first floor construction.

—***nonbearing wall.***—A wall which supports no vertical load other than its own weight.

—***panel wall.***—A nonbearing wall in skeleton construction built between columns or piers and wholly supported at each story.

—***parapet wall.***—That part of an exterior, party, or fire wall extending above the roof line.

—***party wall.***—A wall used jointly by two parties under easement agreement and erected at or upon a line separating two parcels of land that may be held under different ownership.

—***property-line wall.***—A wall built to and along a property line.

—***retaining wall:***

1. Any wall subjected to lateral pressure other than wind pressure.
2. A wall built to support a bank of earth.

—***veneered wall.***—A wall with a masonry facing, which is attached to but not bonded so as to form an integral part of the wall for purposes of load bearing and stability.

framing systems:

—***balloon framing.***—A system of framing a building in which all vertical structural elements of the bearing walls and partitions consist of single pieces extending from the top of the foundation sill to the roof plate and to which all floor joists are fastened.

—***braced framing.***—A system of framing a building in which all vertical structural elements of the bearing walls and partitions, except corner posts, extend for one story only, starting at the foundation sill for the first-story framing and at the top plate of the story below for all stories above the first: corner posts extend from foundation sill to roof plate and are braced by diagonal members usually extending the full height of each story and crossing several of the studs on each side.

—***platform framing.***—A system of framing a building on which floor joists of each story rest on the top plates of the story below (or on the foundation sill for the first story) and the bearing walls and

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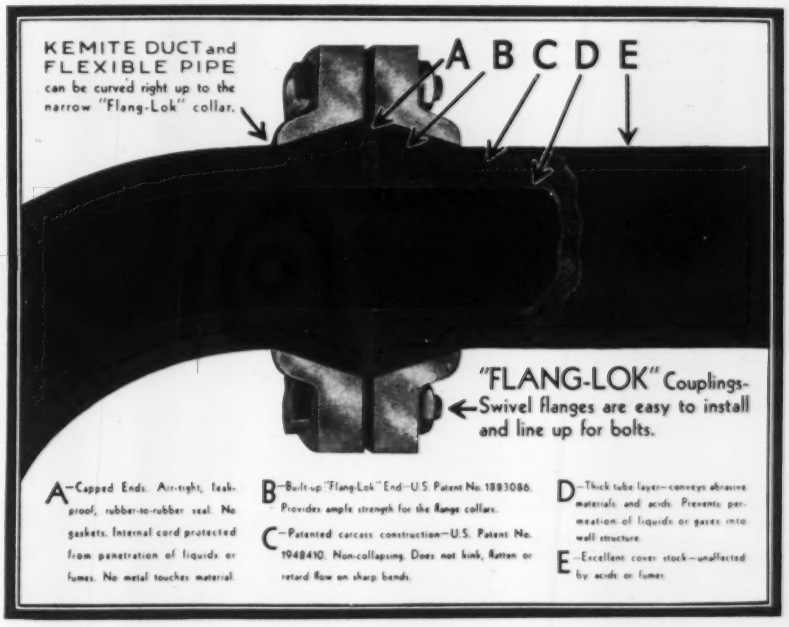
Thru the wall, around supporting columns, down thru the floor . . . No couplings for 50 to 150 feet (depending on size) . . . Nothing to corrode . . . Nothing to crack, shatter or break. Vibration and quick changes of temperature do not effect it. Goodite Patented Pipe and Kemite Duct solve new handling problems in old plants.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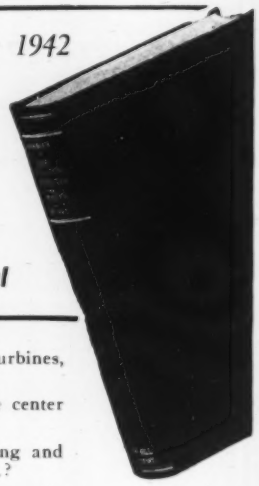

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partitions rest on the subfloor of each story.

—***lumber.***—The product of the saw and planing mill that is further manufactured than by sawing, resawing, and passing lengthwise through a standard planing machine, cross-cutting to length and working.

—***boards.***—Yard lumber less than 2 inches thick, 8 or more inches wide.

—***dressed size.***—The dimensions of lumber after planing; usually ⅜" less than the nominal or rough size; for example, a 2" x 4" stud actually measures 1⅝" x 3⅝". (*See* LUMBER: NOMINAL SIZE.)

—***kiln-dried lumber.*** — Lumber dried by artificial heat to a moisture content which is less than can normally be obtained through the natural process commonly known as air seasoning.

—***matched lumber.***—Lumber that is edge dressed and shaped to make a close tongue-and-groove joint at the edges or ends when laid edge-to-edge or end-to-end.

—***nominal size.***—As applied to timber or lumber, the ordinary commercial size by which it is known and sold in the market. (*See* LUMBER: DRESSED SIZE.)

—***plank.***—A broad board, usually more than 1" thick, laid with its wide dimension horizontal and used as a bearing surface.

—***rough lumber.*** — Lumber undressed as it comes from the saw.

—***shiplapped lumber.*** — Lumber that is edge dressed to make a close rabbetted or lapped joint.

—***surfaced lumber.***—Lumber that is dressed by running it through a planer.

(NOTE.—It may be surfaced on one side (S1S), two sides (S2S), one edge (S1E), or on a combination of sides and edges: (S1S1E), (S2S1E), (S1S2E), or (S4S).)

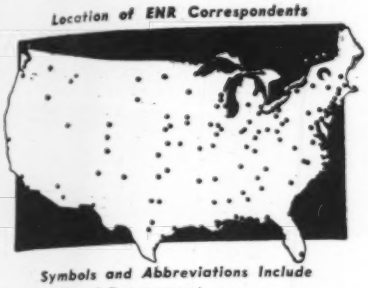
• • •

The city council of Massillon, Ohio, recently indicated that it was interested in the municipal ownership of a water system, when it passed resolution authorizing bond issues to finance a survey of facilities of the Ohio Water Co., a privately owned utility.

CONSTRUCTION REPORTS

Compiled by Business News Department—Engineering News-Record, 330 W. 42nd St., New York
ELSIE EAVES, Manager *SCOTT McLEOD, Statistician*
(Daily service also available—Write for details)

Location of ENR Correspondents



Symbols and Abbreviations Include

† Federal Government
★ Project of $500,000 or over
ENR Engineering News-Record Construction Daily
CD
A-E-M Architect — Engineer-Management type of contract.

Projects—By Size

Construction projects here reported cover the United States and Canada, are of these minimum sizes or larger; water supply, earthwork, waterworks, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

Classes of Construction

(Named in order of Listing)

Water Supply	Unclassified
Sewers, Waste Disposal	Latin America
Bridges, Grade Cross'gs	Public Buildings
Streets & Roads	Commercial Buildings
Earthwork, Waterways	Industrial Buildings

Stages Reported

PROPOSED: (except Streets & Roads):

BIDS ASKED (new announcements only. For full calendar, see also preceding issues of ENR);

LOW BIDDERS: On jobs below $500,000 value all low bidder news will be the final reports published on the projects involved except where award is not made to the low bidder. In this case, a supplementary contract award report will be published.

CONTRACTS AWARDED: Except awards to low bidders previously reported in low bidder stage.

Dates shown are of issue in which last previous report was published.

Note: To comply with censorship requirements, addresses on some reports are being generalized. Data which would reveal the purpose of the improvements and the size are withheld. The name of contractor and general area are reported.

WATER SUPPLY

BIDS ASKED

Bids Asked November 2

†Va., Accotink—At office Fairfax County Clerk, Fairfax, water and sewerage sys. addns. $43,862. **FWA.** CD 2/27—ENR 3/5.

Bids Asked November 4

†N. C., Wilmington—City, King's Bluff water supply project, Docket N.C. 31-119. **FWA.** Bids 10/14 rejected. J. A. Loughlan, city engr.; adv. ENR 10/22. CD 10/19, under LB.

Bids Asked About November 5

Mo., Kansas City—City, c/o A. Everham, dir. P. Wks., 2 mi. 24x42 rein.-con. pipe line. R. McKinley, city engr.

LOW BIDDERS

†California—U. S. Eng., 751 S. Figueroa St., Los Angeles, Oct. 16, water supply and sewage disposal sys., Solicitation 864, Riverside Co., from Oilfield Constr. Co., 2650 Cherry Ave., Long Beach, over **$100,000.**

Ill., Chicago—Dpt. P. Wks., O. E. Hewitt, comr., Sept. 28, 36 in. rein.-con. water pipe, fittings, from Material Service Corp., 33 N. LaSalle St., **$118,082.**

†La., Alexandria—City, Oct. 13, gathering, service and supply lines, from Dellone Constr. Co., Thomas Bldg., 1316 Wood St., Dallas, Tex. **FWA.** CD 9/25—ENR 10/1.

†Texas—U. S. Eng., Fort Sam Houston, Oct. 11, drilling casing, developing water well. Spec. 42-534 Bexar Co., from Wm. Cravens & Son, 501 Hays St., San Antonio, under **$50,000.** CD 10/6.

CONTRACTS AWARDED

†Alabama—U. S. Eng., U. S. Courthouse & Customhouse, Mobile, 3 wells, pumps, motors, houses. Inv. 569-43-220, Pickens Co., to Layne Central Co., 1993 Chelsea Ave., Memphis, Tenn. Est. **$40,000.**

Conn., Norwich—Water Bd., City Hall, 10 and 12 in. watermains, Boswell Ave. and N. Main St.; pipe, to Warren Pipe Co. of Massachusetts, 75 Federal St., Boston, Mass.; trenches, backfilling, paving to N. Benvenuti & Sons, 16 Elm St., New London, Owner lays pipe. Total est. **$55,000.** CD 8/26.

†Florida—U. S. Eng., U. S. Courthouse & Post Office, Jacksonville, water supply, sewerage sys., Inv. Neg. Jax 43-289, Duval Co., to Murphy Constr. Co., Clare Ave., West Palm Beach, under **$100,000.** Awarded 10/7.

†Florida—U. S. Eng., Court House, Jacksonville, water supply, sewerage collection and treatment sys., Inv. Neg Jax 43-299, Lake Co., to C. T. Dawkins, 2424 Chicago Ave., Tampa, under **$50,000.** Awarded 10/12.

†Maryland—Washington Suburban Sanitary Comn., Hyattsville, 1,825 ft. c.i. watermains and 5,825 ft. vitr. sewer, Contr. No. 159 W & S, to W. G. Fritz Co., Inc., 69 Main St., West Orange, N. J. **$34,653.** Bids 9/16. CD 9/10.

★**†Michigan**—U. S. Eng., 700 Union Guardian Bldg., Detroit, water and sewer mains, etc., Macomb Co., to Getman Bros., South Haven, under **$1,000,000.**

†North Carolina—U. S. Eng., Charlotte, water and sewer lines, to Boyle Constr. Co., Sumter, S. C.; sewage disposal plant, to D. M. Rickenbaker, Union, S. C., both Union Co. Bids 10/10.

★**†Ohio**—U. S. Eng., U. S. Post Office & Courthouse, Cincinnati, laying pipe for Mill Creek Valley Water Supply Project No. Ohio 33-234, Miami Erie Canal, Butler, and Hamilton Counties, to Murdock Constr. Co., 1654 Sherman St., Norwood, S. A. Ruebel & Co., 4301 Kirby Rd., Cincinnati, and O'Connell & Sweeney, Inc., Kellogg and Tennyson Sts., Cincinnati, **$500,000-$1,000,000***** gate valve to A. P. Smith***concrete pipe contract, to American Pipe & Constr. Co. and Massey Concrete Products Corp., Melbourne St., Cincinnati***check valves to Rensellaer Valve Co., Ontario St., Troy, N. Y.***well drilling, to Kelly Well Co.***pump. equip., to Deep Well Pump and A. D. Cook, Inc., Lawrenceburg. Bids 9/18. CD 10/2—ENR 10/8, under LB.

†Texas—U. S. Eng., 231 W. Main St., Denison, drilling, casing, developing deep water wells, Solic. 257-43-96, Gray Co., to H. D. Epperson, Ardmore, Okla., under **$50,000.**

†Texas—U. S. Eng., Fort Sam Houston, test water wells, Bexar Co., to Wiegand Bros., Milam Bldg., San Antonio, under **$50,000.**

†Texas—U. S. Eng., Fort Sam Houston, drilling, casing, developing water well. Spec. 42-534, Bexar Co., to Wm. Cravens & Son, 501 Hays St., San Antonio, under **$50,000.** Awarded 10/10.

†Texas—U. S. Eng., 231 W. Main St., Denison, water softening facilities, Solic. 257-43-64, Potter Co., to Stover Water Softening Equip. Co., St. Charles, Ill., under **$50,000.** CD 9/18.

†Texas—U. S. Eng., Fort Sam Houston, steel water tank on steel tower, Spec. 42-366, Bexar Co., to Truehart, Caldwell & Lee, Builders Exch., San Antonio, under **$50,000.** Bids about 10/3.

†Texas—U. S. Eng., Fort Sam Houston, water distr. sys., sanitary sewer collection lines, Tex. 42-462, Bastrop Co., to M. F. Fischer & Son, 804 Builders Exch. Bldg., San Antonio, **$100,000-$500,000;** outside overhead electrical distr. sys., Spec. 42-461, Bastrop Co., to Universal Electric Co., 208 S. Haskell St., Dallas, **$50,000-$100,000.** Bids 10/5. CD 9/30.

†Texas—U. S. Eng., Fort Sam Houston, supplemental contract water supply line, Bexar Co., to Trueheart, Caldwell & Lee, 608 Builders Bldg., San Antonio, under **$50,000.** Awarded 10/13. CD 9/16—ENR 9/24 under CA.

†Texas—U. S. Eng., Fort Sam Houston, water distr. lines, facilities, Bell Co., to H. B. Zachry, Harding Blvd., San Antonio, under **$50,000.** Bids 10/5. CD 9/28.

†Texas—U. S. Eng., 25 St. and Avenue F, Galveston, drilling, casing, developing deep water well with electric motor and gasoline stand-by units, Robertson Co., to Layne-Texas Co., 6331 Harrisburg Blvd., Houston, under **$50,000.** Awarded 10/13.

†Washington—U. S. Eng., 800 3 Ave., Seattle, well, Grant Co., to A. A. Durand, 115 Reese Ave., Walla Walla, under **$50,000.**

SEWERS, WASTE DISPOSAL

BIDS ASKED

†Texas—U. S. Eng., Fort Sam Houston, sewage disposal plant addn., Spec. 42-483, Kinney Co. Plans deposit $25.

LOW BIDDERS

★**†Ala., Mobile**—City, Oct. 8, exten. 2 pipe sewer line, **FWA** 1-185, from Carey W. George & Assoc., Mobile. **$960,276.** CD 9/25—ENR 10/1.

Calif., Los Angeles—Bd. P. Wks., Oct. 7, sanitary sewers in Hatteras St. and Camelia Ave. Sewer Dist. 1911, from P. S. Tomich, 501 N. Del Mar Ave., San Gabriel, **$43,995.** Est. $31,643. CD 9/16—ENR 9/24.

†Calif., Richmond — Federal Wks. Agency, 49 4 St., San Francisco, Oct. 15, interceptor sewers, Docket Calif. 4-0333 Contr. 1, from W. J. Tobin, 5708 Glenbrook Dr., Oakland, **$245,569.** CD 9/22—ENR 9/24.

CONTRACTS AWARDED

†California—U. S. Eng., 751 S. Figueroa St., Los Angeles, sewer, water and electrical distr. sys., No. 293, San Diego Co., to H. F. Hendrickson, 2811 Clearwater St., Los Angeles, under **$100,000.** Bids 10/10. CD 10/6.

†Illinois—U. S. Eng., 800 U. S. Court House & Customhouse, St. Louis, Mo., sewage treatment plant alterations, addns., St. Clair Co., to Hoeffken Bros. Supply & Const. Co., 222 W. B St., Belleville, and G. E. Tillman, Centralia. Est. **$100,000-$500,000.** Bids 10/5.

Ill., Des Plaines—E. J. Friedrich, city clk., exten. sewers, to Orfei Contg. Co., 5 Bway., Melrose Park, **$31,617.**

★**†Michigan**—U. S. Eng., 700 Union Guardian Bldg., Detroit, sewer and water sys., Wayne Co., to Shaw Contr. Co., Inc., Birmingham, under **$1,000,000.**

★**†Mich., St. Clair Shores**—Village, section lake shore interceptor sewer, approx. 3 mi. 5 and 6 ft. rein.-con. sewer in tunnel from Macomb-Wayne Co. line to Ten and One Half Mile Rd., to Gargaro Co., Inc., 40 E. Seven Mile Rd., Detroit. **$538,085. FWA.**

†Oklahoma—U. S. Eng., 416 Wright Bldg., Tulsa, concrete and heavy timber drainage structures, Muscogee Co., to Layman & Evans, Braggs, **$50,000-$100,000.**

†Va., Newport News—Federal Works Agency, 606 State Planters Bldg., Richmond, sewerage sys. addn. consisting outfall sewer line along Jefferson Ave. from 58 St. to Boat Harbor, to Kalill Co., 30 E. Broad St., Columbus, O. and C. H. Lawson, Williamsburg. **$82,700.**

†Washington—U. S. Eng., 800 3 Ave., Seattle, sanitary sewerage and water distr. sys., Contr. 8054 and sanitary sewerage and water distr. sys. Contr. 7991, both Spokane Co., to Spencer B. Lane Co., 251 Kearney St., San Francisco, Calif., under **$100,000.**

†Ohio—U. S. Eng., 700 Union Guardian Bldg., Detroit, Mich., remodeling, expanding sewage disposal plant, Putnam Co., to Steinle-Wolfe, Inc., Fremont, under **$1,000,000.**

BRIDGES, GRADE CROSSINGS

BIDS ASKED

Bids Asked October 29

Indiana—State Hy. Comn., S. C. Hadden, chn., Indianapolis, 2 span, 76 ft. rein.-con. girder exten. over Dry Run, W. 10 St., also rein.-con. girder exten. over Little Eagle Creek west of Indianapolis, both Marion Co.; 2 span 28 ft. rein.-con. bridge, also 0.843 mi. concrete paving, Jackson Co. R. Bower, ch. engr. CD 10/16—ENR 10/22, under LB.

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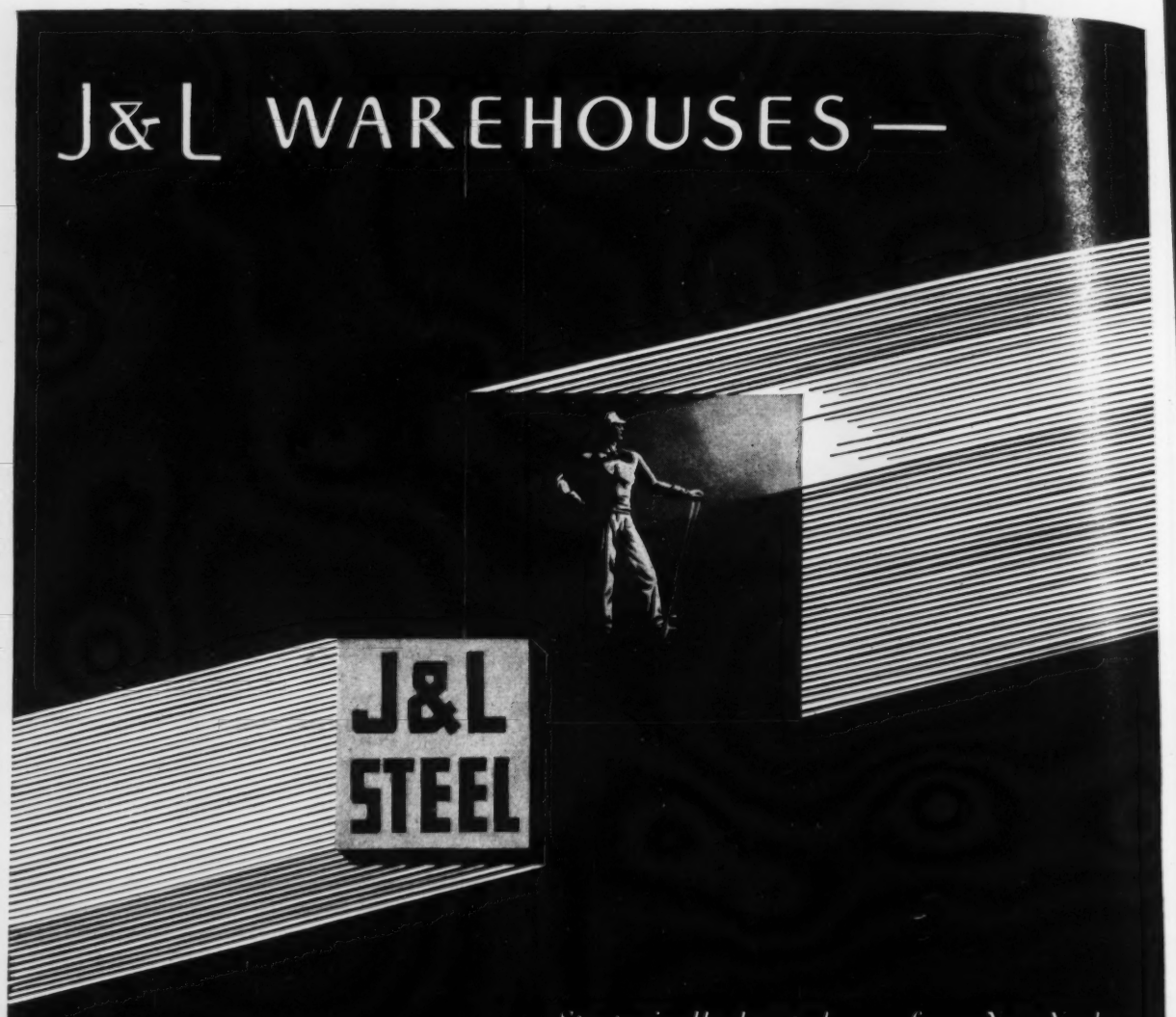

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BRIDGES, etc. (Bids Asked, Cont'd.)

Bids Asked November 5

California—State Div. Hys., State Bldg., Los Angeles, widening bridge across San Diego River, San Diego Co.; traffic light sys. on Lakewood and Compton Blvds., Artesia Ave., South and Center Sts. C. H. Purcell, Sacramento, state hy. engr.

LOW BIDDERS

California—State Div. Hys., State Bldg., Los Angeles, Oct. 15, overhead crossing, San Diego Co., from M. H. Golden, 3489 Noell St., San Diego, **$329,332.** CD 10/5.

Illinois—State Dpt. P. Wks. & Bldgs., Div. Hys., Springfield, Oct. 9, bridge, Montgomery Co., from J. C. Bremer, 629 Roundtree St., Hillsboro, **$70,440***** bridge, Fayette Co., from Thornton & Sons, 2205 Hway., Mattoon, **$103,964***** bridges, Williamson Co., from R. W. Ford, Marion, **$43,957.** CD 10/6.

Indiana—State Hy. Comn., Indianapolis, Oct. 13, bridge, Johnson Co., from Deniston & Garber, Rochester, **$56,956.** Est. $65,265. Received no bids bridges Jackson and Marion Counties. CD 10/1—ENR 10/8.

CONTRACTS AWARDED

Maryland—Washington Suburban Sanitary Comn., Hamilton St., Hyattsville, bridge and road paving, Contr. 160, Howard Co., to Contee Sand & Gravel Co., Laurel, **$32,642.** Bids 10/7. CD 9/30.

Oklahoma—State Hy. Dpt., Oklahoma City, rein.-con. bridge south of Frederick, Tillman Co., to J. Briscoe, Stillwater, **$35,577.** Est. $30,000. Bids 10/13, awarded 10/14. CD 10/7 under Roads.

Quebec—Dpt. Roads, Quebec City, bridge over Simon River between Mount Rolland and Piedmont, Terrebonne Co., to Local Constr. Co., Ltd., 4740 Iberville St., Montreal, about **$80,000.**

STREETS AND ROADS

BIDS ASKED

Bids Asked October 29

Indiana—State Hy. Comn., S. C. Hadden, chn., Indianapolis, 0.257 mi. concrete paving, curbs, sidewalks New Haven Ave. from Beuter Rd., Allen Co.

Wash., Seattle—12,000 sq. yd. concrete sidewalk, 28 Ave. N.E. $34,895. C. L. Wartelle, County-City Bldg., engr.

Bids Asked October 30

Missouri—State Hy. Comn., Jefferson City, grading, culverts, asphaltic concrete or concrete paving road from Telegraph Rd. to Mississippi River Bridge, Route 77 T.R., Project FA 864 A1, C. W. Brown, Jefferson City, engr.

Tennessee—State Hy. Dpt., Nashville, grading, draining, paving 2.049 mi. section Dunn Ave., Elliston and Perry Rds., Shelby Co. CD 10/13—ENR 10/15.

Bids Asked November 3

†**Wash., Renton**—City concrete paving $35,000 sq. yd. 4 Ave. N., Park St. N., Logan and Factory Sts. Over $25,000. **FWA.** Plans deposit $15. J. W. Carey, Empire Bldg., Seattle, engr.

Bids Asked November 4

California — State Div. Hys., Sacramento, grading, untreated rock and armor coat surfacing road between Red Mountain Creek and Riverview Ranch, Mendocino Co. C. H. Purcell, state hy. engr.

Bids Asked November 5

Washington—State Hy. Dpt., B. Bantz, dir., Olympia, constructing right-turn lane, islands, draining, etc. intersection Pacific Hy. and Secondary State Rd. 5-G, Pierce Co.; clearing, grubbing, grading, draining, surfacing 5.928 mi. Rd. 12-E, Lewis Co.; channel change, riprapping roadway embankment slopes State Rd. 3, Columbia Co.; ballasting, surfacing, stockpiling 7.75 mi. State Rd. 3-A, Yakima Co.

Bids Asked November 6

Kentucky—Dpt. Hys., Frankfort, grading, draining 10.23 mi. Henderson-Morganfield Rd., U. S. 60, Henderson Co.; 9.228 mi. Henderson-Morganfield Rd., U. S. 60, Union Co.; 10.969 mi. Canmer-Magnolia Rd., Hart and Larue counties.

Bids Asked

California—State Div. Hys., Sacramento, rejected bids Sept. 16, imprv. 0.6 mi. road, Marin Co. CD 9/21—ENR 9/24, under LB.

Connecticut—State Hy. Dpt., Hartford, received no bids Oct. 13, paving 1,925 ft. railroad delivery yard, Hartford. CD 10/8.

D. C., Wash.—District Comrs., District Bldg., will not receive bids Oct. 22, imprv. Suitland Rd., 38 St., S.E. $30,000. Project withdrawn. CD 10/12.

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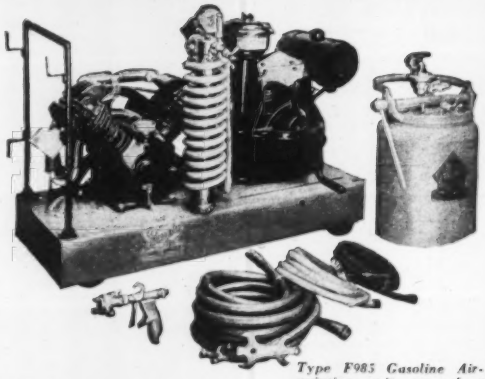

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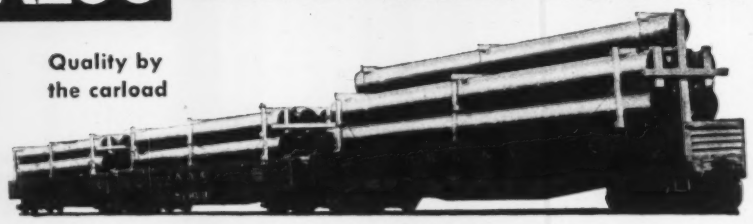

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STREETS, etc. (Bids Asked, [illegible])

Ill., Dixon—Lee Co. receiv[illegible] bids Aug. 24, bituminous surface tre[illegible] 4345 mi. 25-RS-MFT and 0.4833 mi. [illegible] MFT & H Baker, Centennial Bldg., S[illegible] engr. co. roads and city stree[illegible] state CD 8/18.

Ill., Monticello—Piatt Co[illegible] jected bids Aug. 27, concrete paving 0.72[illegible] JW-MFT CD 8/18—ENR 8/20.

Iowa—State Hy. Comn., Ames[illegible] jected bids Oct. 6, imprv. roads Monona [illegible] Harrison Counties. Received no bids [illegible] Webster and Pottawattamie [illegible] Mills counties. CD 9/25—ENR 10/1.

Kansas—State Hy. Dpt., Nor[illegible] rejected bids Sept. 25, imprv. roads, Dec[illegible] Sheridan, Rawlin, Norton and Thomas Counties. CD 9/15—ENR 9/17.

Kansas—State Hy. Dpt., Abil[illegible] rejected bids Sept. 30, imprv. roads Dick[illegible] Chase, Saline and Ottawa Counties. R. [illegible] Keeling, Topeka, engr. CD 9/15.

Kansas—State Hy. Dpt., Sene[illegible] rejected bids Oct. 2, imprv. roads, Nemaha, Wabaunsee, Jefferson and Pottawatomie Counties. CD 9/22—ENR 9/24.

Kansas—State Hy. Dpt., Winfield, rejected bids Oct. 7, imprv. roads Kingman and Rice Counties. CD 9/22—ENR 9/24.

Kansas—State Hy. Dpt., Olathe, rejected bids Oct. 9, imprv. roads, Johnson Co. CD 9/29—ENR 10/1.

†**Texas**—Pub. Housing Auth., NHA Electric Bldg., Fort Worth, received no bids for 6 roads, streets, asphalt paving, installing natural gas distr. sys. and facilities, sanitary sewerage sys., water supply distr. and facilities, site development, outside overhead electrical distr. sys., etc. for housing.

†**Tex., Orange**—City, A. Sokolski, mayor, bids soon grading drainage, shaping streets, grading, hard paving, 2 and 6 Sts. $75,000 authorized by **FWA.**

LOW BIDDERS

California—State Div. Hys., Sacramento, Oct. 14, grading, plant mix surfacing 0.6 mi. Sacramento St. between Route 208 and Freebie St., near Vallejo, Solano Co., from E. A. Forde, 640 Sir Francis Drake Blvd., San Anselmo, **$41,129;** 1.3 mi. Solano Ave. between 4 St., Vallejo, and Route 7, Solano Co., from Chas. L. Harney, 543 Call Bldg., San Francisco, **$65,133.**

California—State Div. Hys., Sacramento, Oct. 14, imprv. 2.1 mi. Contra Costa Co., from Chas. L. Harney, 543 Call Bldg., San Francisco, **$437,495.** CD 9/25—ENR 10/1.

California—State Div. Hys., State Bldg., Los Angeles, Oct. 15, imprv. 2 mi. Redondo Blvd., etc., also 0.6 mi. state hy., both Los Angeles Co., from Vido Kovacevich, 5466 Imperial Hy., South Gate, **$82,077** and **$29,122** respectively. CD 9/25—ENR 10/1.

D. C., Wash.—District Comrs., District Bldg., Oct. 13, concrete paving 23,000 sq. yd. alleys, from W. F. Brenizer Co., 1504 S. Capitol St. Est. **$60,752. CD 10/12.**

D. C., Wash.—District Comrs., District Bldg., Oct. 14, imprv. Independence Ave., from Highway Eng. & Constr. Co. 7 and T Sts. N.E. **$248,496.** CD 10/6—ENR 10/8.

Illinois—State Dpt. P. Wks. & Bldgs., Div. Hys., Springfield, Oct. 9, imprv. 7.65 mi. Coles and Douglas Counties, from The Walker Constr. Co., 421 S. 21 St., Mattoon, **$37,200;** 24,929 sq. yd. Montgomery Co., from Moore Bros., Inc., 2000 St. Clair Ave., East St. Louis, **$159,154.** CD 10/6.

Louisiana—State Dpt. Hys., Baton Rouge, Oct. 14, imprv. 1.79 mi. Rapides Parish, from Robinson & Young, Louisiana Natl. Bank Bldg., Baton Rouge, **$119,497.** CD 10/9.

Md., Baltimore—City, Bd. Awards, Oct. 14, concrete paving, Contr. CC 775, from Paramount Constr. Co., 3700 Gough St., **$24,953.** CD 10/7.

Missouri—State Hy. Comn., Jefferson City, imprv. Project DA-WI-13, St. Louis Co., from S. Kraus Co., 649 Edmund St., St. Louis, **$28,461.** Rejected bids Oct. 3, imprv. 4.549 mi. Harrison Co. Rejected bids Sept. 19, imprv. 3.124 mi. Jackson Co. CD 9/22—ENR 9/24.

Nevada—Dpt. Hys., Carson City, Oct. 15, imprv. 5.61 mi. Clark Co., from Silver State Constr. Co., Inc., S. Maine St., Fallon, **$110,336.** CD 9/29—ENR 10/1.

N. J., Belleville—Town Comrs., Oct. 14, paving, from Thomas Gallo, 1007 Springfield Ave., Irvington, **$110,100.** CD 10/6—ENR 10/8.

North Carolina—State Hy. & P. Wks. Comn., Raleigh, Oct. 14, imprv. 3.42 mi. New Hanover Co., from F. D. Cline, Fairview Rd., Raleigh, **$121,933,** est. $100,000-$125,000; 4.12 mi. Durham and Granville Counties, from J. D. McGuire Constr. Co., Durham, **$66,856,** est. $50,000-$75,000. CD 10/6—ENR 10/8.

Pennsylvania—State Hy. Dpt., Harrisburg, imprv. 1,551 ft. Washington Co., from Moyer

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Pa., Pittsburgh—Comrs. A... Co., for 6, reconstructing ½ mi. sec... Roads Run Rd., Mifflin Twp., from Ben Co... Co., 192 Hay grove St., $49,200. CD 9/24—... 10/2.

Tennessee—State Hy. Dpt., Nashville, let 16, reconstructing base, bitu... as surfaced 28.45 mi. roads, Blount Co., ... Inter-State Constr. Co., 3rd Natl. Ba... Bldg., Nash ville, $177,576. CD 10/5—E... 10/8.

†**Texas**—U. S. Eng., Fort ... Houston roads, bridges, addnl. constru... Spec. G 482 (T2-1), Kinney Co., from ... C. Evans, 1030 W. Olmos St., San Anto... CD 10/8.

Virginia — Dpt. Hys., Richmond, let 15, imprv. 0.6 mi. Fairfax Co., ... Blacken Engineering & Constr. Co., Wa... ton, $25,051. CD 10/9.

CONTRACTS AWARDED

†**Alabama**—U. S. Eng., Talladega, approx. 292,000 sq. yd. paving Talladega Co., to E. ... Lawrence Constr. Co., Red Rock Bldg., At... lanta, Ga. Bids 10/9.

†**Arizona**—U. S. Eng., 751 S. Figueroa St., Los Angeles, Calif., streets, utilities, Mari... copa Co., to Del E. Webb Constr. Co., 36 S. 23 Ave., Phoenix, over $100,000. Awarded 10/15.

†**Florida**—U. S. Eng., U. S. Courthouse & Post Office, Jacksonville, clearing, grubbing, grading, paving, Inv. Neg-Jax 43-284, orange Co., to W. H. Armston Co., Inc., Dunedin, under $50,000. Awarded 10/7.

†**Idaho**—U. S. Eng., Pittock Blk., Portland, Ore., grading, paving, Ada Co., to Jacobsen Jenson Co. and D. J. Cavanagh, 517 N. E. Stanton St., Portland, Ore., $100,000-$500,000.

†**Iowa**—State Hy. Comn., Ames, paving 17... mi. Woodbury Co., to Fred Carlson Co., Decorah. $50,000-$100,000. Federally financed. Awarded 10/3. CD 9/15—ENR 9/17, under Lit.

†**Maine**—U. S. Eng., Park Sq. Bldg., Boston, Mass., roads, railroad spur tracks, Aroostook Co., to T. J. Harvey & Son, E. Hoosac St., Adams, Mass. Est. $50,000-$100,000. Bids 10/2. CD 10/8, under Unclassified.

†**Massachusetts**—U. S. Eng., Park Square Bldg., Boston, gravel roads, No. 175-43-NEG-106, Plymouth Co., to Berke-Moore Co., 31 Boylston St., Boston. Est. $25,000. Bids 10/...

★†**Michigan**—U. S. Eng., 700 Union Guardian Bldg., Detroit, roads, Washtenaw Co., to J. W. Bihlmire, Three Oaks, less than $1,000,000.

†**Mississippi**—U. S. Eng., Post Office, Vicksburg, roads, streets, Hinds Co., to Morrison & Knost, 709 Jackson Ave., Vicksburg. Est. $100,000-$500,000.

†**Oklahoma**—U. S. Eng., 416 Wright Bldg., Tulsa, roads, drainage work, streets, Sch. 957-Neg. 43-67, Comanche Co., to A. G. Sherwood Constr. Co., Independence, Kan., $100,000-$500,000.

†**Oklahoma**—U. S. Eng., 416 Wright Bldg., Tulsa, grading, drainage, Kay Co., to A. G. Sherwood Const. Co., Independence, Kan., under $100,000.

Oklahoma—State Hy. Dpt., Oklahoma City, imprv. 6.7 mi. Cleveland Co., to J. J. Thompson & Son, Muskogee, $136,744, est. $138,000. 1.5 mi. Tillman Co., to J. Briscoe, Stillwater, $40,700, est. $42,000. Bids 10/13. CD 10/7.

Pennsylvania—State Hy. Dpt., I. L. Hughes, secy., Harrisburg, macadam on stone paving 2.79 mi. Rural Route 22026, Dauphin Co., own forces, $60,600. T. C. Frame, ch. engr.

†**Tennessee** — U. S. Eng., P. O. Box 97, Memphis, finish grading, graveling, surfacing streets and roads, gravel walks, drainage, etc., Dyer Co., to Memphis Stone & Gravel Co., Exchange Bldg., Memphis, under $500,000.

†**Texas**—U. S. Eng., Fort Sam Houston, addnl. roads, flexible walks, drainage, to Morgan Constr. Co., Inc., Akard St., Dallas, under $50,000; concrete culverts, grading, to M. E. Ruby, Littlefield Bldg., Wallace & Bowden, 5513½ E. Grand St., Austin, $50,000-$100,000, both Spec. 42-495. Bids about 10/6. CD 10/2.

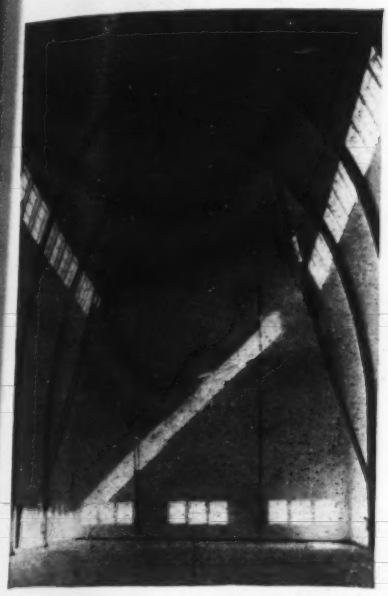
†**Texas**—U. S. Eng., Fort Sam Houston, addnl. access roads, clearing, grubbing, asphalt paving, excav., Spec. 42-355, Bell Co., to M. E. Ruby and Wallace & Bowden, Noorwood Bldg., Austin, under $50,000. Bids 10/3. CD 9/28.

†**Texas**—U. S. Eng., Fort Sam Houston, addnl. paving, fencing, Spec. 42-415, Brown Co., to A. L. Bucy, Brownwood, under $50,000. Bids about 10/5, awarded 10/12. CD 9/30—ENR 10/8.

†**Texas**—U. S. Eng., Fort Sam Houston, addnl. roads, parkways construction, paving, Spec. 42-417 T3-17, Brown Co., to H. Page, Norwood Bldg., Austin, $100,000-$500,000. Additional to CD 10/12—ENR 10/15, under CA.

"UNIT" glued laminated ARCHES

Permanent-Fire resistant structures



Laboratory building for the Army Signal Corps —the structure makes use of laminated wood arches of 54-ft. span and 66-ft. rise for the principal roof and sidewall framework. See Engineering News-Record March 12, 1942.

An outstanding structural achievement

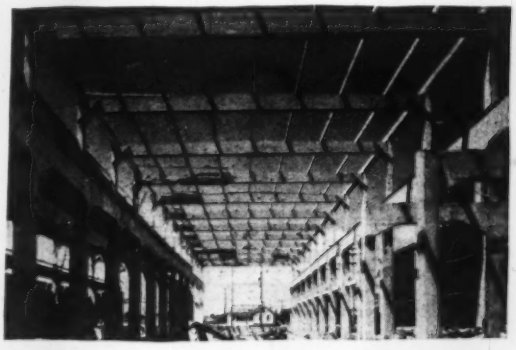
● "UNIT" structures are fabricated from selected kiln dried lumber, glue-welded into solid structural members of any required shape. These members are shop fabricated and shipped ready for immediate erection.

Laboratory tested

A report of tests made by the Forest Products Laboratories at Madison, Wisconsin on full size "UNIT" members is published in U. S. Department of Agriculture Technical Bulletin No. 691, pages 34 to 49 and 70 to 75 inclusive. "UNIT" arches, which were used for the Forest Products Laboratory Building in 1934, were the first all glued laminated arches of this type made in the United States. Since that time "UNIT" structures have been incorporated in hundreds of buildings from coast to coast covering an area of more than five million square feet.

Engineering service

Our Engineering Department is qualified through long experience to assist architects and engineers in the design of "UNIT" structures. Our designs have been used for buildings erected for the Army, Navy, Air Corps, Signal Corps and Defense plants of all types. The services of our Engineering Department are available upon request.



Unit glued laminated beams—span 61'5", spacing 20'0", size of beam 15"x35" provide for efficient and fast factory construction. Note laminated purlins.

Seven car shipment of unit arches, 112' span.

Unit arch span 152'—this hangar was built to accommodate future luxury liners of the airways by Northwest Airlines, Inc., St. Paul, Minn.

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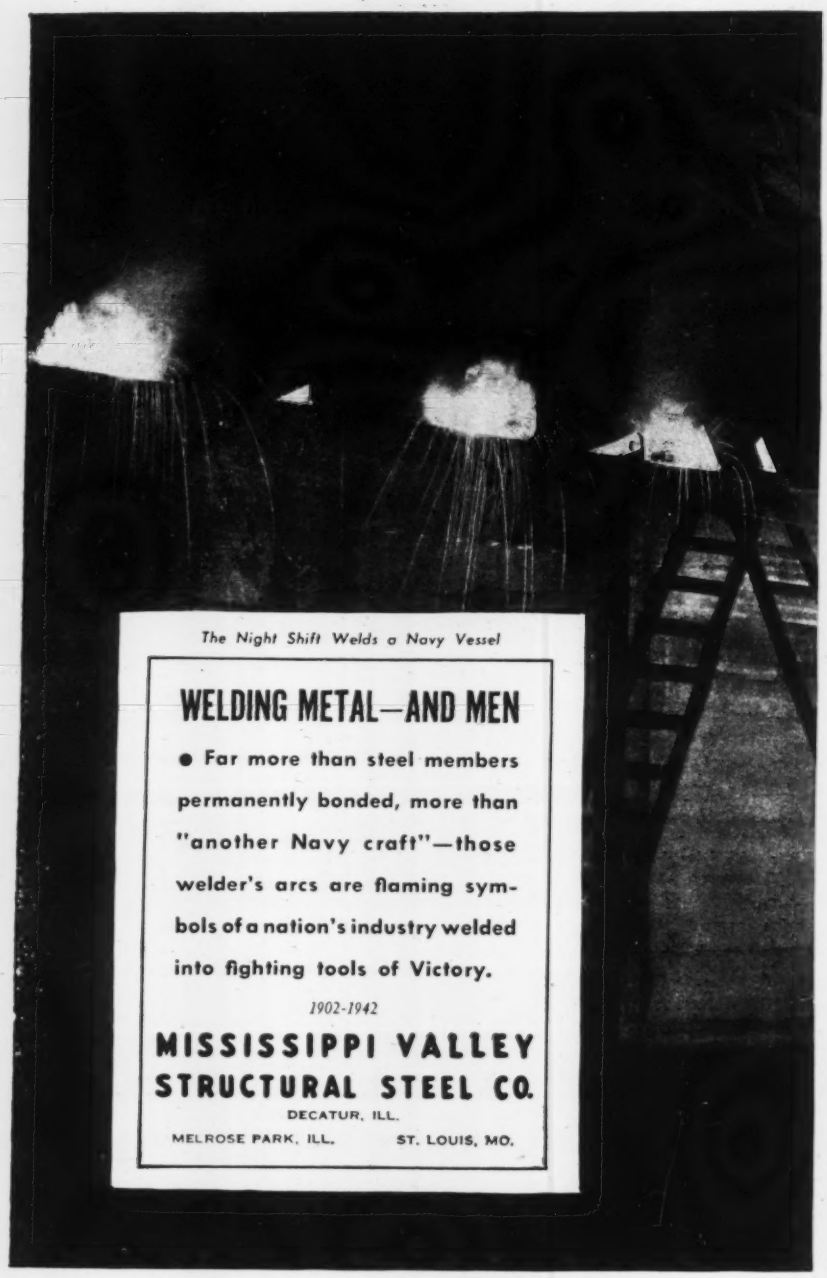
FACTORIES: PESHTIGO, WISC. AND SAYVILLE, L. I., N. Y.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STREETS, etc. (Contracts awarded, Vol. [illegible])

Washington—State Hy. [illegible] impry. 0.281 mi., Clark Co. [illegible] Co., Stock Exchange Bldg., Portland, Ore. **$31,531.** Bids 10/13. CD 10/[illegible]

†**Washington**—U. S. Eng. [illegible] tle, concrete paving, King [illegible] Goerig, 1515 E. Thomas St., Seattle. **$500,000.**

†**Washington**—U. S. Eng. [illegible] tle, highway construction, [illegible] Washington Asphalt Co., 309 W. 39 St., Seattle. under **$50,000.**

†**Washington**—U. S. Eng., [illegible] grading, paving, Pierce Co. [illegible] Asphalt Co., 309 W. 39 St., Seattle. **$100,000.**

†**Washington**—U. S. Eng., [illegible] tle, graing, draining, Thurston [illegible] Grisdale, Shelton. **$100,000-$500,000.**

Ont., Toronto—Asphaltic [illegible] Cherry St., to Godson Constg. [illegible] Richmond St. W., **$48,748.**

Quebec—Dpt. Roads, Quebec [illegible] graveling, bituminous concrete [illegible] Hy. 2, Deschambault Village to Neuville, **$47,900;** earthwork and straightening 0.88 mi. Hy. 4, Halifax and Ireland south of Ulysse St. Marie, Beauport, **$25,000.**

Que., Donnacona—Paving several streets, day labor. **$25,000.** M. Devito, Town Hall, engr. CD **8/13.**

EARTHWORK WATERWAYS

PROPOSED WORK

†**Texas**—Defense Plant Corp., 811 Vermont Ave. N.W., Wash., D. C., earthen and concrete dam, Cherokee Co. **$250,000.** Industrial company will operate. McCrossin & Co., 120 Wall St., New York, N. Y., consult. engrs.

BIDS ASKED

Bids Asked October 27

N. Y., New York—Comr. Parks, at office Dpt. Parks, Arsenal Bldg., Central Park 64 St. and 5 Ave., reconstructing seawall, incidental work along south and west shore Randall's Island, Contr. M-104-142

Bids Asked November 2

Wash., Tacoma—City, station power and light switchboard for La Grande powerhouse, part second Nisqually power development.

†**Idaho**—Bureau Reclamation, Boise, clearing part Anderson Ranch Reservoir site, Boise Project, 20 mi. N.E. Mountain Home. Spec. 1673-D.

Bids Asked November 13

†**Idaho**—Bureau Reclamation, Boise, diversion and outlet tunnel for Cascade Dam, Payette Div., Boise Project, near Cascade. Spec. 1050.

LOW BIDDERS

†**Arkansas**—U. S. Eng., Courthouse & Post Office, Vicksburg, Miss., 405,000 cu. yd. levee on Mississippi River, Desha Co., from H. B. Blanks Co., Jackson, **$50,000-$100,000.**

†**California**—Bureau Reclamation, Custom House, Denver, Colo., four regulation gates for installation in spillway, Keswick Dam, Kennett Div., Central Valley Project, Shasta Co., Spec. 1045, from American Bridge Co., Frick Bldg., Pittsburgh, Pa., **$169,051.** CD 9/22—ENR 9/24.

Wash., Tacoma—City, Oct. 13, 13.8 kv bus and equip. for La Grande powerhouse, from Railway & Industrial Engineering Co., 166 Jackson St., Seattle, **$32,200.** CD 9/21—ENR 9/24.

CONTRACTS AWARDED

★†**Arkansas**—U. S. Eng., 300 Bway., Little Rock, clearing 1,100 acres at Norfolk Dam, Baxter Co., to Nelson Tie Co., Humble, Tex., est. under **$1,000,000;** clearing 1,100 acres, same location, to Schutte Co., Genoa, Wis., est. under **$1,000,000.** CD 8/19.

†**Mississippi**—U. S. Eng., Courthouse and Post Office, Vicksburg, 740,000 cu. yd. levee enlargement on Mississippi River, Bolivar Co., to H. B. **Potashnick, Cape Girardeau, Mo. $100,000-$500,000.** Bids 9/11, awarded 9/24.

★†**New Mexico**—Bureau Reclamation, Tucumcari, earthwork and 7,000 ft. irrigation tunnel in conjunction with Conchos Dam. Spec. 1047, Tucumcari Project, to Bressi-Bevanda Constructors, Inc., 208 W. 8 St., Los Angeles, Calif., **$752,205.** Bids 10/6, awarded 10/7. CD 9/9—ENR 9/17 under BA.

Tex., Velasco—Town, c/o Drainage Bd., Velasco, earthen levees and drainage facilities along harbor front, to A. Friedrich, Velasco, **$42,300.**

†**Washington**—U. S. Eng., 860 3 Ave., Seattle, dredging Whatcom Co., to General Constr. Co., 3840 Iowa St., Seattle, under **$50,000.**

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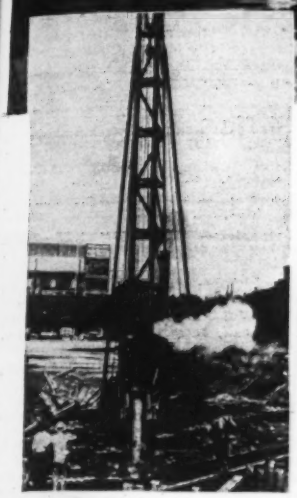

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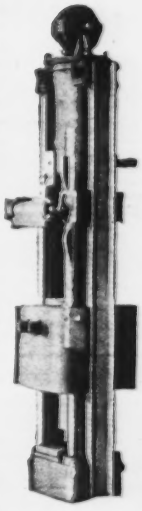

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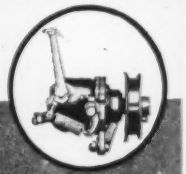

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EARTHWORKS, etc. (Contracts Awarded Cont'd.)

Que., St. Hyacinthe—Municipality, retaining wall, to Dansereau Ltée, 1347 Bernard St., Outremont, **$30,000.**

UNCLASSIFIED

PROPOSED WORK

†Alabama—IMPROVEMENTS—U. S. Eng. U. S. Courthouse & Custom House, Mobile, addnl. imprvs., Jefferson Co., W. Goodwin and E. B. Van Keuren, Martin Hldg., Birmingham, engrs. and archts.

†Arkansas—IMPROVEMENTS—U. S. Eng. U. S. Post Office & Courthouse, Vicksburg, Miss., bids soon, imprvs., drainage and lighting sys., fencing, etc. Plans deposit $25.

★**†Fla., Bartow** — IMPROVEMENTS — City, imprvs. $500,000. CAA.

†Fla., Bunnell — IMPROVEMENTS — Town, imprvs. CAA.

★**†Fla., Key West**—IMPROVEMENTS—City, imprvs. $1,000,000. CAA.

†Fla., Kissimmee—IMPROVEMENTS—City, imprvs. $400,000. CAA.

★**†Fla., Miami** — IMPROVEMENTS — City, imprvs. $1,000,000. CAA.

★**†Fla., New Smyrna**—IMPROVEMENTS—City, imprvs. $1,000,000. CAA.

★**†Fla., Palatka** — IMPROVEMENTS — City, imprvs. $800,000. CA.

★**†Fla., Punta Gorda**—IMPROVEMENTS—Town, imprvs. $700,000. CAA.

Ill., Sterling—IMPROVEMENTS—City plans imprvs.

★**†Ia., Burlington**—IMPROVEMENTS—City, voted $150,000 bonds, enlarging imprvs. Est. $1,000,000. CAA. CD 10/2—ENR 10/8.

★**†Me., Bar Harbor** — IMPROVEMENTS—Town, imprvs. $570,000. CAA.

★**†Me., Portland**—IMPROVEMENTS—City, imprvs. $700,000. CAA.

★**†Me., Princeton**—IMPROVEMENTS—Town, preliminary surveys imprvs. $700,000. CAA.

★**†Me., Rockland**—IMPROVEMENTS—Town, surveys soon, imprvs. $506,000. CAA.

★**†Mass., Beverly**—IMPROVEMENTS—City, D. E. McLean, mayor, City Hall, imprvs. $500,000. CAA.

†Mass., Hyannis—IMPROVEMENTS—Town, imprvs. $420,000. CAA.

★**†Minn., Alexandria** — IMPROVEMENTS—City, H. S. Campbell, clk., imprvs. $850,000. $50,000 bond election soon to purchase addnl. land. CAA. C. Erickson, Alexandria, engr.

★**Missouri**—IMPROVEMENTS — City of St. Louis, c/o M. H. Dovne, chn. Municipal Airport Comn., City Hall, St. Louis, bids soon, 1st section imprvs., Bridgeton and St. Louis Co. $3,200,000.

†N. H., Portsmouth — IMPROVEMENTS—City, City Hall, preliminary surveys, imprvs. $345,000. CAA.

★**N. D., Fargo**—IMPROVEMENTS—C. O. Jorgenson, city clk., $300,000 bond election Nov. 3, imprvs. Over $500,000. W. P. Tarbell, city engr.

★**†Oklahoma** — IMPROVEMENTS — U. S. Eng., 416 Wright Bldg., Tulsa, imprvs., bldgs., underground utilities, outside electric distr. sys., roads and streets, Alfalfa Co. Over $2,000,000.

★**†Ore., Eugene** — IMPROVEMENTS — Civil Aeronautics Admin., Boeing Field, Seattle, Wash., imprvs., grading, paving. $600,000.

★**†S. C., Chester**—IMPROVEMENTS—City-Chester Co., imprvs. $795,000. CAA.

★**†Vt., Burlington**—IMPROVEMENTS—City Municipal Offices, City Hall, preliminary surveys soon, imprvs. $500,000. CAA.

BIDS ASKED

Bids Asked October 30

†Me., Rockland — LIGHTING IMPROVEMENTS—Civil Aeronautics Admin., LaGuardia Field, Jackson Heights, N. J., lighting imprvs.

†N. J., Atlantic City—IMPROVEMENTS—Civil Aeronautics Admin., LaGuardia Field, Jackson Heights, N. Y., New York, N. Y., imprvs., excav., paving. Plans deposit $10.

Bids Asked November 5

†Arkansas—IMPROVEMENTS—U. S. Eng., Post Office, Vicksburg, Miss., imprvs., Garland Co.

Ill., Chicago — PEDESTRIAN PASSAGEWAYS FINISH, etc.—City, at office P. Harrington, comr. Subways & Superhighways, 20 N. Wacker Dr., finish for pedestrian passageways and access mezzanines, Contr. F-5A; adv. ENR 10/22.

UNCLASSIFIED (Bids Asked, Cont'd.)

Bids Asked

†**Maine**—PARKING AREAS—U. S. Eng., Park Sq. Bldg., Boston, Mass. (selected bidders), parking areas, Penobscot Co.

†**Massachusetts**—PLUMBING—U. S. Eng., Park Square Bldg., Boston, (selected list bidders), plumbing work, No. 175-43-NEG 112, Suffolk and Norfolk Counties.

†**Oklahoma**—GRADING, etc.—U. S. Eng., 221 W. Main St., Denison, Tex., imprvs., grading, drainage, asphalt paving, etc., Inv. 257-42-101, Bryan Co. $100,000. Plans deposit $25.

†**Oklahoma**—IMPROVEMENTS—U. S. Eng., 416 Wright Bldg., Tulsa, imprvs., Contr. I, clearing, grading, hard paving, etc., Alfalfa Co. Plans deposit $30.

†**Oklahoma**—GRADING, etc.—U. S. Eng., 416 Wright Bldg., Tulsa, grading, drainage, hard paving, Solic. 957-Neg-43-93, Tulsa Co. $200,000. Plans deposit $30.

†**Texas** — SITE IMPROVEMENTS — Pub. Housing Auth., NHA, Electric Bldg., 7 and Taylor Sts., Fort Worth, site imprvs., utility work. Plans deposit $25. Wittenberg & Delaney, 807 Pyramid Bldg., Little Rock, Ark., archts.

†**Texas**—FUEL STORAGE, etc.—U. S. Eng., 25 St. and Avenue F, Galveston, a.c. gasoline and fuel storage facilities, Midland Co. Over $25,000.

LOW BIDDERS

†**California** — TUNNEL — U. S. Eng., 751 S. Figueroa St., Los Angeles, Oct. 14, outlet tunnel at dam, San Luis Obispo Co., from Morrison-Knudsen Co., 810 Title Guarantee Bldg., Los Angeles, under $500,000.

†**California**—RAILROAD SPUR—U. S. Eng., 751 S. Figueroa St., Los Angeles, Oct. 14, railroad spur, No. 229, Orange Co., from Shannahan Bros., 6193 Maywood Ave., Huntington Park, under $100,000.

Ill., Chicago—STATION EQUIPMENT—City at office P. Harrington, comr. Subways & Superhighways, 20 N. Wacker Dr., Oct. 15, agents booths, etc., Contr. T, Order 2, from Schick-Johnson Co., 1737 N. Paulina St., $64,470. CD 10/6—ENR 10/8.

Mo., Chillicothe — IMPROVEMENTS — Civil Aeronautics Auth., 410 E. 12 St., Kansas City, Mo., imprvs., Schedules 1, 2 and 3, Livingston Co., from Atkinson-Windle Co., Chillicothe. Total est. $110,000. CD 9/30.

†**Nevada**—IMPROVEMENTS—Civil Aeronautics Administration, 1500 4 St., Santa Monica, Calif., clearing, grading, paving, drainage, airport, Pro. 63-153, Pershing Co., from Axman & Miller, McMinnville, Ore., $304,755. CD 10/1—ENR 10/8.

†**Nevada**—IMPROVEMENTS—U. S. Eng., 4550 Brazil St., Los Angeles, Calif., Oct. 10, imprvs., Nye Co., from C. J. Paradis, 2320 Idell St., Los Angeles, Calif. Est. under $50,000.

†**Nevada**—IMPROVEMENTS—U. S. Eng., 751 S. Figueroa St., Los Angeles, Calif., Oct. 12, imprvs., Inv. 297, Nye Co., from O. J. Senum, 2646 29 St., Santa Monica, Calif. Est. under $50,000.

†**South Carolina** — CLEARING, etc. — U. S. Eng., Fort Jackson, Oct. 9, clearing, grubbing, grading, paving, Orangeburg Co., from H. E. Wolfe, St. Augustine, Fla. CD 10/6.

†**Texas**—FACILITIES—U. S. Eng., Fort Sam Houston, Oct. 7, underground facilities, sewer pipeline, gasoline dispensing sys., steel tanks, pump, unit, dispen. stations, water distr. sys., Spec. 42-480, from Waco Co., Inc., Amicable Bldg., Waco, $50,000-$100,000. CD 10/2.

★†**Texas** — IMPROVEMENTS — U. S. Eng., Fort Sam Houston, Oct. 9, imprvs. construction, Fort Sam Houston, Oct. 9, imprvs. construction, hard paving, etc., Spec. 42-283, Taylor Co., from Harco Constr. Co. and Waco Co., Waco, $500,000-$1,000,000.

CONTRACTS AWARDED

†**Alabama** — AIR CONDITIONING — U. S. Eng., U. S. Courthouse & Customhouse, Mobile, air conditioning, Montgomery Co., to Engineering Contractors, Inc., Bona Allen Bldg., Atlanta, Ga.

†**Alabama**—IMPROVEMENTS—U. S. Eng., Talladega, imprvs. and bldg., Talledega Co., to Plowden & Roberts, 1420½ Taylor St., Columbia, S. C. Bids 10/12.

†**Arizona**—IMPROVEMENTS—U. S. Eng., Albuquerque, N. M., imprvs., grading, hard paving, Cochise Co., to A. Pinner, Jr., 116 W. 24 St., Los Angeles, Calif., $100,000-$500,000. CD 8/28—ENR 9/3.

†**Arkansas**—IMPROVEMENTS—U. S. Eng., 300 Bway., Little Rock, imprvs., to C. H. Peterson & Co. and Thornton Bros., 2920 27 Ave S., Minneapolis, Minn. Awarded 10/2.

†**Arkansas**—UTILITIES—U. S. Eng., P. O. Box 97, Memphis, Tenn., utilities, Lawrence Co., to G. H. Caseman Constr. Co., Poplar Bluffs, Mo., under $50,000.

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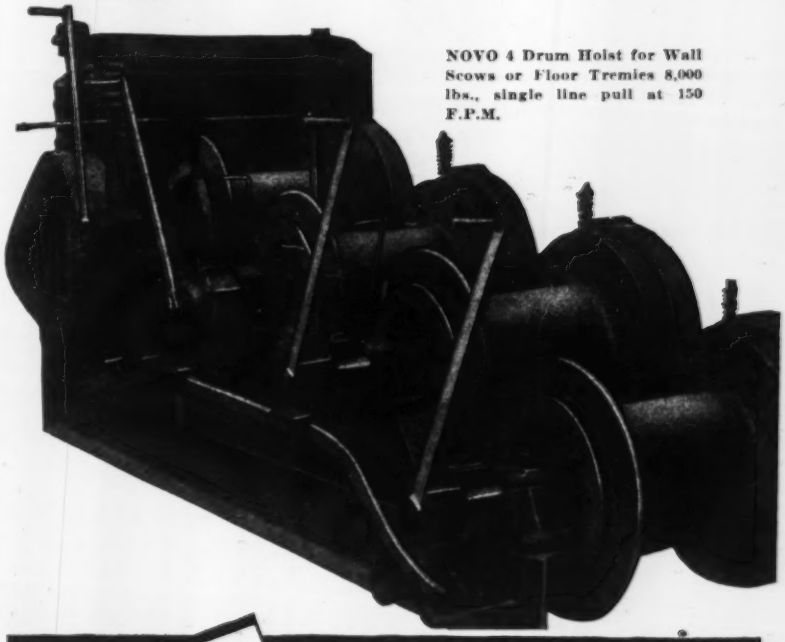

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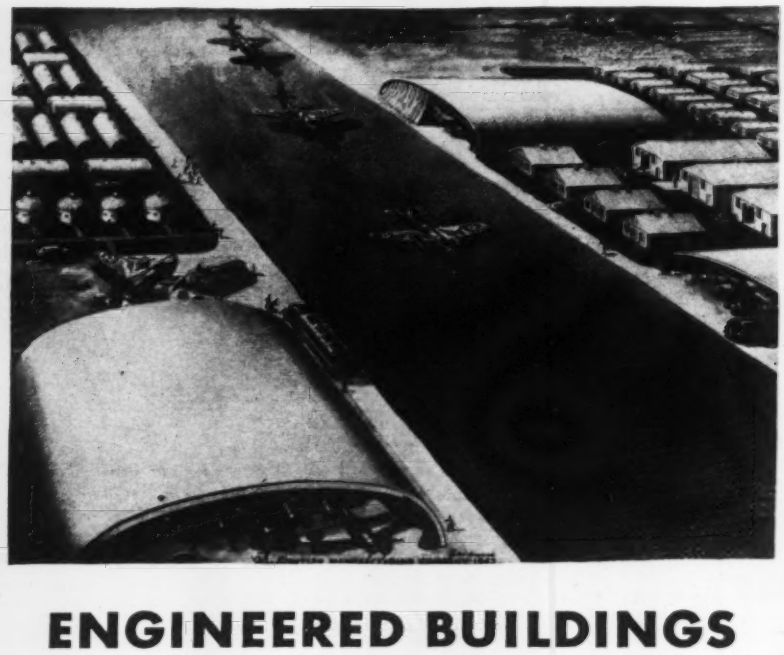

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UNCLASSIFIED (Contracts A... Contr...

★†**Arkansas**—IMPROVEMEN... U. S. Eng. 300 Bway., Little Rock, ... Co., to Megarry Bros., 437 2... Jackson, Minn. Est. **$500,000-$1,000,000.**

†**California**—IMPROVEMENT... S. Eng. 751 S. Figueroa St., Los Ange... Co., to Basich Bros., 20,536 N... Torrance, over **$100,00.** Award...

†**California**—IMPROVEMENT... S. Eng. 74 New Montgomery St., S... imprvs., Marin Co., to Cen... Constr. Co., 230 California St.,...

†**California**—IMPROVEMENTS... S. Eng. 74 New Montgomery St., S... imprvs., Sonoma Co., to F... 369 Pine St., San Francisco. A...

†**Connecticut** — ELECTRICAL... TRIBU... TION—U. S. Eng., 819 Industrial ... Providence, electric distr. sys., N... Hartford Co., to Theodore D. B... Rear 276, Franklin Ave., Hartford ... der **$50,000.**

†**Florida**—BULK GAS STORAGE ... YSTEM— U. S. Eng., Court House, Jackson... rary bulk gas storage sys., Inv. ... 43-6, Sarasota Co., to J. B. Gree... & Equip Co., Sarasota, under $50,000. Awarded 10/12.

†**Florida** — SPRINKLER SYSTE... — U. S. Eng., Court House, Jacksonville, ... sprinkler system, Inv. Neg. 43-393, ... Moore Pipe & Sprinkler Co., 1139 W. ... Jacksonville, under **$50,000.** Awarded 10/12.

†**Florida** — SPRINKLER SYSTEM — U. S. Eng., Court House, Jacksonville, ... sprinkler system, Inv. Neg. Jax 43-... lands Co., to Moore Pipe & Sprinkler Co., 1139 W. State St., Jacksonville, under $50,000.

★†**Florida**—CLEARING, etc.—U. S. Eng. U. S. Courthouse & Post Office, Jacksonville, clearing, grubbing, grading, paving, Inv. Neg. Jax 43-290, Collier Co., to J. L. Cone, and J. D. Manley, both Caesar Ave. and Cumberland St., Tampa, under **$1,000,000.** Awarded 10/6.

†**Florida**—GAS FUELING SYSTEM—U. S. Eng., U. S. Courthouse & Post Office, Jacksonville, gas fueling sys., Inv. Neg-JAX 43-276, Lee Co., to Murphy Constr. Co., Clare Ave., West Palm Beach, under **$100,000.** Awarded 10/6.

†**Florida** — IMPROVEMENTS — U. S. Eng., U. S. Courthouse & Post Office, Jacksonville, imprvs., roads, etc., Inv. Neg-JAX 43-283, Polk Co., to John E. Ballenger Constr. Co., Lakeland, under **$50,000;** clearing, grubbing, grading, etc., Inv. Neg-Jax 43-294, to Sutton Constr. Co., Lakeland, under **$50,000;** electric distr. sys. Inv. Neg-Jax 43-291, to Brandon Electric Co., Deland, under **$50,000.** Awarded 10/7.

†**Florida** — IMPROVEMENTS — U. S. Eng., U. S. Courthouse & Post Office, Jacksonville, imprvs., Jackson Co., Inv. NEG-MA-43-16, to J. B. Gibson Constr. Co., Donalsonville, Ga., less than **$200,000.** Awarded 9/27.

†**Idaho**—IMPROVEMENTS—U. S. Eng., 628 Pittock Blk. S.W., Portland, Ore., Ada Co., to Vernon Bros. Co., 8 and Orchard Sts., Boise. Est. **$150,000.**

†**Illinois**—CLEARING, etc.—U. S. Eng., 8... U. S. Court House & Custom House, St. Louis, Mo., clearing site, removal all existing bldgs., debris, etc., St. Clair Co., to J. E. Latta Co., Route 10, Ferguson, Mo. Est. under **$50,000.**

†**Illinois**—ELECTRIC DISTRIBUTION SYSTEM, etc.—Winnebago County Housing Auth., Rockford, overhead electric distr. gas and water distr. sys., sewers, grading, lawns, etc., for NHA, to Milburn Bros., Mt. Prospect, **$168,602.**

†**Illinois** — SPRINKLER SYSTEM — U. S. Eng., U. S. Court House & Custom House, St. Louis, Mo., sprinkler sys. in bldgs., St. Clair Co., to Fire Protection Co., 6601 S. Narragansett Ave., Chicago. Est. under $50,000. Bids 9/26.

†**Louisiana**—IMPROVEMENTS—U. S. Eng., U. S. Post Office & Courthouse, Vicksburg, Miss., imprvs., Ouachita Parish, to McBride & Son, Bastrop, under **$50,000.** Awarded 10/14.

†**Louisiana**—AIR CONDITIONING—U. S. Eng., foot of Prytania St., New Orleans, air conditioning sys., Inv. 43-124, to Equitable Equipment Co., 410 Camp St., New Orleans.

†**Louisiana**—FUELING SYSTEM—U. S. Eng., foot of Prytania St., New Orleans, A.C. fueling sys., Inv. 43-115, to Aqua Systems, Inc., 385 Gerard Ave., New York, N. Y. Bids 10/5, awarded 10/8. CD 10/1.

†**Maine** — CONSTRUCTION — Government Agency, construction, incl. grading, retaining walls, roads, plate racks, 10 mi. trackage, to W. H. Hinman Co., North Anson. Est. **$200,000.** Industrial Company will operate.

†**Maine**—CONSTRUCTION—U. S. Eng., Park Square Bldg., Boston, Mass., construction work, tile installation No. 175-43-NEG 85, Cumberland Co., to M. Frank Higgins Co., 30 Lincoln St., Boston, Mass. Est. under **$50,000.** Bids 9/23.

†**Maine**—CONSTRUCTION, etc.—U. S. Eng., Park Sq. Bldg., Boston, Mass., construction work, heating sys., No. 175-43-NEG 102, Cum-

UNCLASSIFIED (Contracts Awarded, Cont'd.)

berland Co., to Fels Co., 42 Union St., Portland. Est. under **$50,000.**

†**Massachusetts** — PLUMBING — U. S. Eng., Park Sq. Bldg., Boston, plumbing, No. 175-43-Neg 112, Suffolk and Norfolk Counties, to J. M. McCusker Co., 1140 Columbus Ave., Boston. Est. under **$50,000.**

†**Massachusetts and New York**—PLUMBING —U. S. Eng., Park Sq. Bldg., Boston, Mass., construction plumbing, various counties in above states, to Lappin Brothers, Inc., 7 Irving St., Malden. Est. **$35,000.**

†**Massachusetts** — CONSTRUCTION — U. S. Eng., Park Square Bldg., Boston, concrete construction, No. 175-43-NEG 105, Plymouth Co., to Rich Bros., 27 Clenmont Rd., Brighton. Est. under **$50,000.**

†**Massachusetts** — UTILITIES — U. S. Eng., 819 Industrial Trust Bldg., Providence, R. I., utilities, No. 699-43-NEG 70, Bristol Co., to Edward M. Matz, Inc., 101 Moraine St., Jamaica Plain. Est. under **$50,000.** Bids 9/25.

★†**Michigan**—ELECTRICAL SYSTEM—U. S. Eng., 700 Union Guardian Bldg., Detroit, electrical distr. sys., to Modern Electric Constr. Co., Mount Clemens; roads and walks, to C. Larsen, Northville, both Macomb Co., less than **$1,000,000.**

★†**Michigan**—FENCING—U. S. Eng., 700 Union Guardian Bldg., Detroit, fencing, Crawford Co., to Cadillac Fence & Supply Co., 13440 Wyoming St., less than **$1,000,000.**

★†**Michigan**—GASOLINE FUELING SYSTEM—U. S. Eng., 700 Union Guardian Bldg., Detroit, gasoline fueling sys., Crawford Co., to Walters Constr. Co., Inc., 37-49 58 St., Woodside, N. Y. Est. under **$1,000,000.**

†**Mississippi** — FUELING SYSTEM — U. S. Eng., Post Office, fueling sys., Washington Co., to L. O. Brayton Co., Dyersburg, Tenn., under **$50,000.**

†**Missouri** — IMPROVEMENTS — U. S. Eng., P. O. Box 97, Memphis, Tenn., imprvs., re-erecting bldgs., Dunklin Co., to S. C. Caruthersville, under **$50,000.** CD 10/13—ENR 10/15.

★†**Missouri**—IMPROVEMENTS—U. S. Eng., P. O. Box 97, Memphis, Tenn., imprvs., Pemiscot Co., to Modern Homes, Inc., St. Elmo, Ill., under **$500,000.**

†**Nebraska** — ELECTRICAL DISTRIBUTION SYSTEM — U. S. Eng., 1709 Jackson St., Omaha, outside electrical distr. sys., Buffalo Co., to Schneider Electrical Works, 1108 Farnam St., Omaha.

†**Nebraska** — ELECTRICAL DISTRIBUTION SYSTEM — U. S. Eng., 10 E. 17 St., Kansas City, Mo., outside electrical distr. sys., Clay Co., to Schneider Electrical Works, 1108 Farnam St., Omaha.

†**Nebraska** — ELECTRICAL DISTRIBUTION SYSTEM—U. S. Eng., 1709 Jackson St., Omaha, outside electrical distr. sys., Dodge Co., to Schneider Electrical Works, 1108 Farnam St., Omaha.

†**Nebraska** — ELECTRICAL DISTRIBUTION SYSTEM—U. S. Eng., 10 E. 17 St., Kansas City, Mo., outside electrical distr. sys., Fillmore Co., to Schneider Electrical Works, 1108 Farnam St., Omaha.

†**Nebraska** — ELECTRICAL DISTRIBUTION SYSTEM—U. S. Eng., 10 E. 17 St., Kansas City, Mo., outside electrical dist. sys., Thayer Co., to Schneider Electrical Works, 1108 Farnam St., Omaha.

Neb., Norfolk — IMPROVEMENTS — A. O. Hazen, city clk., completing imprvs., **WPA. $100,000.**

†**New Jersey**—RAILROAD—U. S. Eng., 120 Wall St., New York, N. Y., railroad facilities, Middlesex Co., to Wilson Bros., 96 Mercer Ave., North Plainfield, under **$50,000.**

†**New Mexico** — IMPROVEMENTS — U. S. Eng., Albuquerque, imprvs., Otero Co., to Skousen Brothers, 205 Springer Bldg., Albuquerque, under **$200,000.** Awarded 10/15.

†**New Mexico**—RAILROAD—U. S. Eng., Albuquerque, railroad, McKinley Co., to Wacox Constr. Co., Waco, Tex., under **$200,000.** Awarded 10/15. CD 10/13—ENR 10/15.

†**North Carolina**—IMPROVEMENTS—U. S. Eng., Charlotte, imprvs., Mecklenburg Co., to Blythe Bros. Co., 424 S. Brevard St., Charlotte. Bids 10/9.

★†**Ohio**—IMPROVEMENTS—U. S. Eng., 700 Union Guardian Bldg., Detroit, Mich., imprvs., Cuyahoga Co., to Schirmer Peterson Co., 6830 Beaver St., Cleveland, less than **$1,000,000.**

†**Oklahoma**—IMPROVEMENTS—U. S. Eng., 416 Wright Bldg., Tulsa, imprvs., grading, etc., Noble Co., to Koss Constr. Co., Old Colony Bldg., Des Moines, Ia., **$100,000-$500,000.** CD 9/15—ENR 9/17.

†**Oregon**—LIGHTING SYSTEM—U. S. Eng., Pittock Blk., Portland, lighting sys., Washington Co., to H. C. Moss Constr. Co., Zenith, Wash. CD 9/9.

†**Rhode Island**—UTILITIES—U. S. Eng., 819 Industrial Trust Bldg., Providence, service utilities, No. 699-43-75, Washington Co., to C. Reppucci & Sons, Inc., 10 Garden Court St., Boston, Mass. Est. under **$50,000.** CD 10/2—ENR 10/8.

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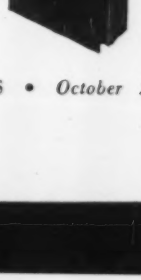

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†**Rhode Island** — CONSTRUCTION — U. S. Eng., 819 Industrial Trust Bldg., Providence, construction work No. 699-43-49, Newport Co., to P. T. Cox Constr. Co. and Spearin Preston & Burrows, Newport. Est. over **$25,000.** Bids 9/8. CD 9/3.

★ †**Tennessee**—COMPASS SWINGING BASE—U. S. Eng., Tullahoma, compass swinging base, to Rule & Murphy, Memorial Apt., Nashville, under **$1,000,000.** CD 9/23.

†**Tennessee**—COMPASS SWINGING BASE—U. S. Eng., 306 U. S. Courthouse, Nashville, compass swinging base, Coffee Co., to Rule & Murphy, Memorial Apt., Nashville.

†**Texas**—ELECTRICAL SYSTEM—U. S. Eng., Fort Sam Houston, electrical distr. sys., incl. fire alarm facilities, Spec. 42-368, Bexar Co., to American District Telegraph Co., 305 N. Presa St., San Antonio, under **$50,000.** Bids 9/14, awarded 10/14. CD 9/10.

†**Texas**—ROW SPRIGGING, etc.—U. S. Eng., 25 St. and Avenue F, Galveston, row sprigging, row sodding, 1,433 acres McLennan Co., to Cage Bros., Bishop, under **$50,000.**

†**Texas** — ELECTRICAL DISTRIBUTION SYSTEM—U. S. Eng., Fort Sam Houston, electrical distr. sys., Spec. 42-482, Kinney Co., to Universal Electrical Const. Co. of Alabama, Inc., 2421 Driscoll St., Houston, under **$50,000.** Bids 10/6. CD 10/1.

†**Texas**—AIR CONDITIONING—U. S. Eng., Fort Sam Houston, air conditioning link trainer bldg., incl. electric service, etc., Spec. 42-427, Bexar Co., to V. Prassel, Builders Exch., San Antonio, under **$50,000.** Bids about 10/10. CD 10/6.

†**Texas**—GASOLINE SYSTEM, etc.—U. S. Eng., 25 St. and Avenue F, Galveston, a.c. gasoline and fuel sys., Tom Green Co., to Aqua Systems, Inc., P. O. Box 752, San Antonio, **$50,000-$100,000.** Bids about 10/3.

†**Texas**—GRADING, etc.—U. S. Eng., 231 W. Main St., Denison, grading, drainage, clearing, hard paving, Grayson Co., to Gifford-Hill & Co., State Bank Bldg., Dallas, **$100,000-$500,000;** imprvs., Grayson Co., to Public Constr. Co., Denison, **$50,000-$100,000.**

†**Texas**—UTILITIES—U. S. Eng., Fort Sam Houston, addnl. underground utilities, Spec. 42-357, Bell Co., to H. B. Zachry Co., Harding Blvd., San Antonio, **$50,000-$100,000.** Bids 10/3. CD 9/29.

†**Texas**—UTILITIES—U. S. Eng., Fort Sam Houston, underground utilities, Spec. 42-457, Bastrop Co., to R. E. McKee, 1918 Texas St., El Paso, under **$50,000.** CD 9/24.

†**Washington**—CONSTRUCTION—U. S. Eng., 800 3 Ave., Seattle, concrete construction, Pierce Co., to J. Helstrom, Astoria, Ore., under **$50,000.**

†**Washington** — ELECTRICAL DISTRIBUTION—U. S. Eng., 810 3 Ave., Seattle, electrical distr. sys. and street lights, Spokane Co., to Consolidated Electrical Contractors, 619 W. 1 Ave., Spokane, under **$50,000.** CD 10/9.

†**Washington**—FIRE ALARM SYSTEM—U. S. Eng., 800 3 Ave., Seattle, fire alarm sys., Pierce Co., to American District Telegraph Co. of Washington, Douglas Bldg., Seattle, under **$50,000.**

†**Washington**—SPRINKLER SYSTEM—U. S. Eng., 800 3 Ave., Seattle, automatic sprinkler sys., Pierce Co., to Grinnell Co. of Pacific, Elliott and Bay Sts., Seattle, under **$50,000.**

Alta., Whitla — IMPROVEMENTS — Dpt. Transport, Ottawa, Ont., imprvs. to Geo. Smith, Maple Creek, Sask., about **$44,000.**

LATIN AMERICA

Mexico, Vera Cruz—Dpt. Public Bldgs. & Communications, c/o Hr. H. Jara, of Dpt. of Navy, Mexico City, plans shipyard and dock. $5,000,000.

PUBLIC BUILDINGS

PROPOSED WORK

★ †**Ala., Mobile**—Pub. Housing Auth., NHA. Georgia Savings Bank Bldg., Peachtree and Broad Sts., Atlanta, Ga., development ordered 2,986 unit dormitory apartments, Ala-1106; 620 unit temporary dormitories, Ala-1167.

★ †**Ark., Bauxite**—Pub. Housing Auth., NHA. Electric Bldg., 7 and Taylor Sts., Fort Worth, Tex., 1,205 unit temporary housing, Ark-3049.

★ †**Ark, Bauxite**—Pub Housing Auth., NHA. 135 dormitory apartments, Ark-3047; 550 temporary dormitories Ark-3048.

★ †**Calif., Alameda** — Pub. Housing Auth., NHA, 785 Market St., San Francisco, 1,400 unit housing, Cal-4113; 600 unit housing, Cal-4114.

★ †**Calif., Benicia**—Pub. Housing Auth., NHA, 785 Market St., San Francisco, 200 dormitory apartments, Cal-4019; 200 unit temporary housing, Cal-441.

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PUBLIC BLDGS. (Proposed Work, Cont'd.)

★†**Calif., Oakland** — Pub. Housing Auth., NHA., 785 Market St., San Francisco, 450 unit housing, Cal-4115; 550 unit housing, Cal-4116.

★†**Calif., Richmond** — Pub. Housing Auth., NHA, 785 Market St., San Francisco, 800 unit temporary housing, Cal-4112; 1,200 unit temporary housing, Cal-4414.

★†**Calif., San Diego** — Pub. Housing Auth., NHA., 785 Market St., San Francisco, priority certificate granted 300 unit demountable housing, Calif-4258.

★†**Ga., Brunswick** — Pub. Housing Auth., NHA, Georgia Savings Bank Bldg., Peachtree and Broad Sts., Atlanta, development ordered 1,000 unit temporary dormitories, Ga-9123.

★†**Ill., Decatur**—Pub. Housing Auth., NHA, 201 N. Wells St., Chicago, 1,100 unit housing, Ill-11171, and 256 dormitory units, Ill-11172.

★†**Ill., Springfield**—Pub. Housing Auth., NHA, 201 N. Wells St., Chicago, 1,500 unit housing, Ill-11181, and 394 dormitory units, Ill-11182.

★†**Ind., Evansville** — Pub. Housing Auth., NHA, 201 N. Wells St., Chicago, Ill., development ordered 500 unit temporary housing, Ind-12131; 500 unit temporary housing, Ind-12132; 500 dormitory apartments, Ind-12133.

★†**Ind., Terre Haute-Clinton**—Pub. Housing Auth., NHA, 201 Wells St., Chicago, Ill., 500 unit housing, Ind-12141 and 100 unit housing Ind-12142.

★†**Me., Bath** — Pub. Housing Auth., NHA, 24 School St., Boston, Mass., priority certificate granted 200 unit permanent housing, Me-17021. CD 8/24—ENR 8/27.

★†**Md., Baltimore** — Pub. Housing Auth., NHA, Temporary Bldg. 2, 19 and D Sts. N.W., Wash., D. C., 1,000 unit temporary housing, Md-18162; 25 unit temporary housing, Md-18163; 25 dormitory apartments, Md-18164.

★†**Md., Elkton**—Pub. Housing Auth., NHA, Temporary Bldg. 2, 19 and D Sts. N.W., Wash., D. C., 496 dormitories, Md-18153; 496 dormitories, Md-18154.

★†**Mich., Battle Creek**—U. S. Eng., 520 Merchandise Mart, Chicago, Ill., alterations, installations at Percy Jones Hospital. $1,000,000. L. J. Sarvis, Battle Creek, archt. CD 8/31—ENR 9/3, under Commercial Bldgs.

†**Mich., Detroit**—Pub. Housing Auth., NHA, Barium Tower Bldg., development ordered 960 unit dormitory apartments, Mich-20058 and 48 unit dormitory apartments, Mich-20059.

★†**Mich., Muskegon**—Pub. Housing Auth., NHA, 9 St. and Prospect Ave., Cleveland, O., 200 unit temporary housing, Mich-20032; 300 unit temporary housing, Mich-20033.

★†**New Hampshire**—Pub. Housing Auth., NHA, 24 School St., Boston, Mass., sketches by A. T. Granger, Main St., Hanover, permanent housing, N. H. 27031. $500,000.

★†**N. J., Camden**—Pub. Housing Auth., NHA, 270 Bway., New York, N. Y., 1,000 unit housing, NJ-28043, and 300 unit housing, NJ-28045.

★†**New York**—U. S. Eng., 960 Ellicott Square Bldg., Buffalo, letter of intent with E. I. duPont de Nemours & Co., Inc., du Pont Bldg., Wilmington, expansion manufacturing plant, Niagara Co. Over $1,000,000.

★†**N. C., Durham**—U. S. Eng., 308 Customhouse, Wilmington, expansion bldgs., $2,000,000.

★†**N. C., Elizabeth City**—Pub. Housing Auth., NHA, Georgia Savings Bank Bldg., Peachtree and Broad Sts., Atlanta, Ga., development ordered 100 unit temporary dormitories, NC-31082; 550 unit, demountable housing, NC-31083.

★†**O., Canton**—Pub. Housing Auth., NHA, 9 St. and Prospect Ave., Cleveland, 200 unit temporary housing, Ohio-33034; 120 unit temporary housing Ohio-33036.

★†**O., Dayton**—Pub. Housing Auth., NHA, 9 St. and Prospect Ave., Cleveland, 50 dormitories, Ohio-33152; 200 dormitory apartments, Ohio-33153; 570 unit permanent housing, Ohio-33057.

★†**O., Massillon**—Pub. Housing Auth., NHA, 9 St. and Prospect Ave., Cleveland, 200 unit temporary housing, Ohio-33035.

★†**O., Sandusky**—Pub. Housing Auth., 9 St. and Prospect Ave., Cleveland, development ordered 250 unit demountable housing, Ohio-33092; 100 unit permanent housing, Ohio-33093. CD 4/30—ENR 5/7.

★†**Ore., Portland**—Pub. Housing Auth., NHA, Skinner Bldg., 5 Ave. and Union St., Seattle, Wash., 6,000 unit temporary housing, Ore-35057; 1,000 dormitories, Ore-35058.

★†**Ore., Portland** — Pub. Housing Auth., NHA, Skinner Bldg., 5 Ave. and Union St., Seattle, Wash., 2,972 unit housing, Ore-35055; 1,464 dormitory apartments, Ore-35056.

★†**Pennsylvania**—Pub. Housing Auth., NHA, 270 Bway., New York, N. Y., housing.

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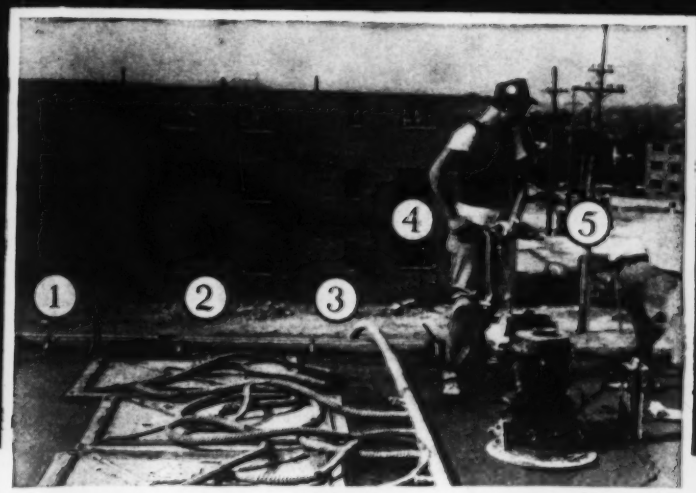

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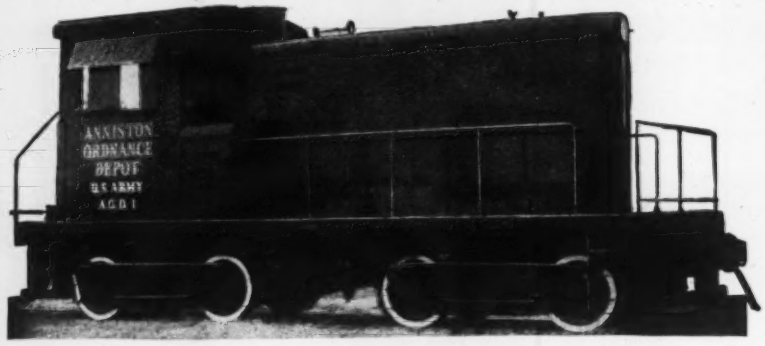

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PUBLIC BLDGS. (Proposed W...

★**†Pennsylvania**—Pub. Hous... 270 Bway., New York, ... NHA, granted 400 unit demountable ... 36302, Beaver Co.

★**†Pa., Butler**—U. S. Eng., 32... Bldg., Pittsburgh, ... Federal Pennsylvania Tuberculosis H... $2,000,000. Hunting, Davis & ... Century Bldg., Pittsburgh, archt. ... —ENR 10/15.

★**†Pa., Erie**—Pub. Housing Au... Bway., New York, N. Y., 200 ... Pa-36024.

★**†Pa., Phila.**—Pub. Housing A... 270 Bway., New York, N. Y. ... housing, Pa-36253; 200 units, Pa... units, Pa-36256; 400 units, Pa-362... Pa-36266; 150 units, Pa-36268; 2... 36269; 150 units, Pa-36267; 105 units, Pa-36281; 750 units, Pa-36255; 800 units, Pa-36283; ... units, Pa-36282.

★**†Pa., Pittsburgh**—Pub. Hous... NHA 270 Bway., New York, N. Y. ... unit housing, Pa-36106; 150 units, ... 250 units, Pa-36109; 500 units, Pa-36... units, Pa-36107.

★**†Texas**—Defense Plant Corp., 811 Vermont Ave. N.W., Wash., D. C., addition to ... for plant. $2,930,000. Industrial ... company will operate.

★**†Texas**—Pub. Housing Auth., NHA, Electric Bldg., Fort Worth, housing.

★**†Tex., Fort Worth**—Pub. Housing Auth., NHA, Electric Bldg., Fort Worth, 500 unit housing, Tex-41224.

★**†Tex., Texarkana**—Pub. Housing Auth., NHA, Electric Bldg., Fort Worth, Tex., 770 dormitories, Tex-4114. Reassigned from Farm Security Admin.

★**†Utah, Ogden**—Pub. Housing Auth., NHA, Dierks Bldg., 10 St. and Grand Ave., Kansas City, Mo., 1,800 dormitory apartments, Utah 42018.

★**†Va., Newport News**—Pub. Housing Auth., NHA, Temp. Bldg. 2, 19 and D Sts., Wash., D. C., 1,000 dormitories, Va-44043. Reassigned from Farm Security Admin.

★**†Wash., Seattle**—Pub. Housing Auth., NHA, Skinner Bldg., 5 Ave. and Union St., 1,000 dormitory apartments, Wash-45136; 200 temp. dormitory apartments, Wash-45127 (T); 600 dormitory apartments, Wash-45128; 200 temp. dormitory apartments, Wash-45129 (T); 500 dwelling units, Wash-45161.

★**†Wash., Tacoma**—Pub. Housing Auth., NHA, Skinner Bldg., 5 Ave. and Union St., Seattle, 400 unit housing, Wash-45016.

★**†W. Va., Point Pleasant**—Pub. Housing Auth., 9 St. and Prospect Ave., Cleveland, O., development ordered 500 dormitory apartments, W. Va. 46038; 300 unit demountable housing, W. Va. 46035. CD 8/11—ENR 8/13.

BIDS ASKED

Bids Asked After October 26

★**†New York**—Pub. Housing Auth., NHA, 270 Bway., New York, temporary housing, NY-30084; temporary dormitories, NY-30085. Mayer & Whittlesey, 31 Union Square, New York, archt.

Bids Asked October 30

†Pennsylvania—Pub. Housing Auth., NHA, 270 Bway., New York, N. Y., housing, Pa-36085. Extended date. CD 10/13—ENR 10/1.

Bids Asked November 2

†California—Bureau Reclamation, Denver, Colo., 6 structural-steel pier-nose columns, grillages and accessory metal work, for turbine-draft-tube piers at Keswick Power Plant, Kennett Div., Central Valley Project, Spec. 1672-D. S. O. Harper, ch. engr.

Bids Asked November 6

†Ark., Stuttgart—War Dpt., 20 St. and Constitution Ave. N.W., Wash., D. C., 100 dormitory apartments, Ark. 3041. Reassigned from Pub. Housing Auth., NHA. CD 10/12—ENR 10/15.

Bids Asked November 10

†N. C., Jacksonville—Bd. Comrs. Onslow Co., and Federal Works Admin., 603 State Planters Bldg., Richmond, Va., nurses home and public health center, NC 31-164. J. J. Rowland, 330 N. Queen St., Kingston, archt. Tentative bid date. CD 10/13—ENR 10/15 under BA.

Bids Asked After November 16

★**†Maryland**—Public Bldg. Admin., North Interior Bldg., Wash., D. C., hospital, health center, nurses' home, Md-18-173. Est. $665,000. CD 9/28—ENR 10/1.

Bids Asked About November 17

†Wisconsin—Pub. Housing Auth., NHA, 201 N. Wells St., Chicago, Ill., housing, school and administration bldg., commercial bldg., etc. Bogner, Darby, Law & Potter, 759 N. Milwaukee St., Milwaukee, archts.

Bids Asked

†Massachusetts—Bethlehem-Hingham Shipyard, Inc., E. Howard St., Quincy, (selected list bidders) 1 story, 50x100 ft., concrete, frame dry storage unit. $40,000. Federally financed.

PUBLIC BLDGS. (Bids Asked, Cont'd.)

†**Massachusetts**—U. S. Eng., Park Sq. Bldg., Boston. (selected list bidders), temporary frame bldgs., No. 175-43-Neg 109, Suffolk Co. CD 8/17—ENR 8/20.

†**Massachusetts**—U. S. Eng., Park Sq. Bldg., Boston, Mass. (selected bidders) temporary housing, No. 175/43/Neg. 114, Suffolk Co.

†**New Mexico**—U. S. Eng., Albuquerque, 1 and 2 story, frame bldgs., Eddy Co. $300,000. Plans deposit $100.

†**Oklahoma**—U. S. Eng., 416 Wright Bldg., Tulsa. Cont. 2 bldgs., paving roads, streets, outside electric distr. sys., water, sanitary sewer, gas sys, plans deposit $65; boundary fencing over $25,000., all in Alfalfa Co.

†**Texas**—U. S. Eng., 25 St. and Avenue F, Galveston, recreation bldg., facilities. Over $150,000. Plans deposit $50.

†**Texas**—Pub. Housing Auth., NHA, Electric Bldg., 7 and Taylor Sts., Fort Worth, permanent housing, Tex. 41131; and temporary dormitory bldgs., site imprvs., Tex. 41132. Plans deposit $50 each. W. C. Townes, 1208 W. 10 Ave., Amarillo, archt. CD 8/3—ENR 8/6.

†**Texas**—U. S. Eng., Fort Sam Houston, bids soon, bldgs., Spec. 42-552, Bexar Co. Plans deposit $25.

†**Texas**—U. S. Eng., Fort Sam Houston, bldgs., Spec. 42-451, Matagorda Co. Plans deposit $25.

†**Va., Pulaski**—Pulaski County School Bd., school, Pico Terrace Sect., Pulaski, and school at Dublin. $25,000. **FWA.**

LOW BIDDERS

★†**Kansas**—Pub. Housing Auth., NHA, Dierks Bldg., Kansas City, Mo., demountable houses, 80 acre site, sewerage disposal plant, electric distr. sys., from Monarch Constr. Co., Joplin, Mo. CD 10/13—ENR 10/15.

†**North Carolina**—U. S. Eng., 308 Customhouse, Wilmington, Oct. 13, bldgs., Cumberland Co., from R. K. Stewart & Son, High Point.

†**North Carolina**—U. S. Eng., Durham, Oct. 12, bldgs., Durham Co., from Boyle Constr. Co. and M. B. Kahn Constr. Co., 714 Lady St., Columbia, S. C.

★†**Oklahoma** — U. S. Eng., Wright Bldg., Tulsa, frame type bldgs., area grading, water, sanitary sewer, gas sys., roads, streets, driveways, fencing, Contr. 1, Solic. 957-neg-42-68, from C. M. Suttle, 12 N.W. 8 St., Oklahoma City, **$1,000,000-$5,000,000.** CD 8/31—ENR 9/3.

†**South Carolina**—U. S. Eng., Congaree, Oct. 10, bldgs., Sumter Co., from Avery Lumber Co., Sumter.

†**Virginia**—U. S. Eng., 1 and Douglas Sts. N.W., Wash., D. C., bldg. facilities, from C. M. H. Co., 316 Randolph Pl. Ne., Wash., D. C. **$100,000-$500,000.**

★†**Wisconsin**—E. A. Stubenrauth, engr.-archt., 708 Erie St., Sheboygan, Oct. 15, temporary row houses, Wis. 47012, for Pub. Housing Auth. NHA, 201 N. Wells St., Chicago, Ill., from Kroening Eng. Corp., 4500 W. Mitchell St., Milwaukee, **$593,800.** CD 10/9—ENR 8/13.

†**Wisconsin**—Pub. Housing Auth., NHA, 201 N. Wells St., Chicago, Ill., Oct. 9, housing, incl. dormitories, admin. bldg., infirmary, etc., Wis. 47023(T), from A. H. Proksch, Iron River, Mich., **$464,860.** CD 10/6—ENR 10/1.

CONTRACTS AWARDED

†**Alabama**—U. S. Eng., Anniston, addnl. bldgs., Calhoun Co., to A. R. Abrams Constr. Co., Kemper Bldg., Atlanta, Ga.

★†**Alabama**—U. S. Eng., U. S. Courthouse & Customhouse, Mobile, temporary bldgs., Lee Co., to Smith, Yetter & Griffin Co., 337 North Ave., Palm Beach, Fla. Est. over $500,000. Bids 10/12.

†**Alabama**—U. S. Eng., U. S. Courthouse & Customhouse, Mobile, general contract bldg., Inv. 569-43-176, Mobile Co., to Foster & Creighton, Natl. Bank Bldg., Nashville, Tenn. Est. **$40,000.** CD 10/9—ENR 10/15, under LB.

★†**California**—Industrial Company, bldgs., to E. S. McKittrick Corp., 5905 Pacific Blvd., Huntington Park. Est. **$2,500,000** incl. equip. Defense Plant Corp. will finance.

†**California**—U. S. Eng., 74 New Montgomery St., San Francisco, bldg., Santa Clara Co., to Wells P. Goodenough, 49 Wells Ave., Palo Alto. Awarded 10/16.

†**California**—U. S. Eng., 74 New Montgomery St., San Francisco, bldg., San Luis Obispo Grand View Ave., San Francisco. Awarded 10/15.

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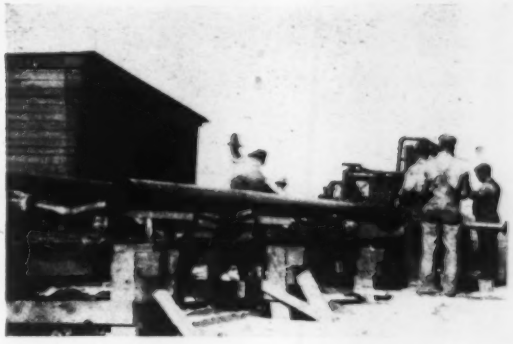

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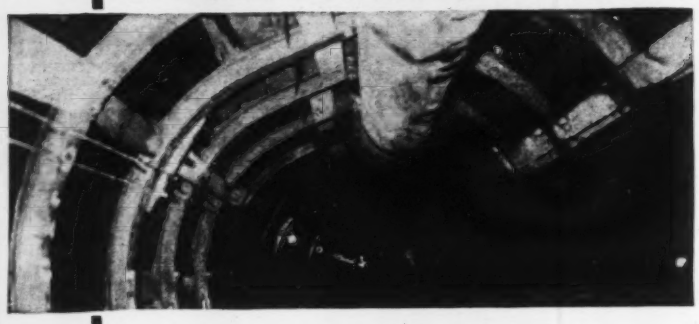

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PUBLIC BLDGS. (Contracts Awa... Cont'd.)

†**California**—U. S. Eng., 74 Ne... St., San Francisco, bldg., San... Co., to V. H. Moore, 157 Lorrin... Awarded 10/15.

†**California**—Housing Auth., ... Cheda Bldg., San Rafael, bldg.... Liebert & Trobock, C. W. Cal... Liebert Associates, Albert Bldg.... CD 10/13—ENR 10/15.

†**California**—U. S. Eng., 75 N... ery St., San Francisco, bldg., t... Route 7, Sacramento.

★†**California** — U. S. Eng., W... Sacramento, bldgs., Spec. 105... to F. C. Stolte Co., 1405 San A... Alameda, to exceed **$3,000,000**... work, to Del Monte Electric... Grove and Clifford Electric Co., 83... Oakland. CD 7/20—ENR 7/23.

†**California** — National Advisory ... Aeronautics, Ames Aeronautical ... Moffett Field, bldg., Santa Clara ... W. P. Goodenough, 49 Wells Ave., ... electrical work, to El Camino Electric ... 2411 El Camino Real, Palo Alto. Est. $250,000.

†**California**—U. S. Eng., 74 New ... ery St., San Francisco, housing, ... to C. H. Bessett Bldg. Co., 826 Wa... Burlingame.

†**California**—U. S. Eng., 751 S. Figueroa St., Los Angeles, reception center bldgs., Riverside Co., to J. B. Constr. Co., 5572 Valley Blvd., Los Angeles, less than **$500,000**. Awarded 10/6.

†**Connecticut**—U. S. Eng., 819 Industrial Trust Bldg., Providence, R. I., bldgs., Inv. **699-43-76, Hartford Co., to E. Turgeon**, 614 Turks Head Bldg., Providence, R. I., electrical work, to Springfield Electrical Co., Inc., 51½ Taylor St., Springfield, Mass. Bids 10/3. CD 10/1.

†**Connecticut**—Pub. Housing Auth., NHA, 24 School St., Boston, Mass., frame demountable housing, Conn. 6092, to City Lumber Co. of Bridgeport, Inc., 75 3 St., Bridgeport. Est. **$350,000.** CD. 10/5—ENR 10/8.

†**Connecticut** and **Massachusetts**—U. S. Eng., 819 Industrial Trust Bldg., Providence, R. I., bldgs., Hartford Co., Conn., to Home Guild, Inc., 47 E. 34 St., New York, N. Y., and bldgs., New Haven, Conn., and Bristol Co., Mass., to Cuzzi Bros. & Singer, Inc., 10 S. 2 Ave., Mt. Vernon, N. Y., both No. 699-43-77. Est. **$100,000-$500,000.**

†**Florida**—U. S. Eng., Court House, Jacksonville, bldg., Inv. Neb. M.D. 43-8, Hillsborough Co., to Fred Howland, Inc., Postal Bldg., Miami, under **$100,000.** Awarded 10/11.

★†**Florida**—U. S. Eng., Court House, Jacksville, bldg., Inv. Neg. Jax143-282, Hillborough Co., to G. A. Hanson Co., Inc., 1312 1st Natl. Bank Bldg., Tampa, under **$1,000,000.** Awarded 10/13.

†**Georgia**—U. S. Eng., Post Office Bldg., Savannah, bldg. addn., Houston Co., to Stillwell Const. Co., Macon.

†**Georgia** — U. S. Eng., U. S. Post Office Bldg., Savannah, bldgs., Richmond Co., to Claussen-Lawrence Const. Co., Augusta.

†**Ga., Marietta**—U. S. Eng., Marietta, bldg., Cobb Co., to Hardin & Ramsey, Inc., 161 Spring St., N.W., Atlanta.

★†**Illinois**—U. S. Eng., 222 North Bank Dr., Chicago, general contract bldgs., Fulton Co., to John Feimley Co., Bloomington, Ill. Est. exceeds **$5,000,000.**

†**Illinois**—U. S. Eng., U. S. Court House and Custom House, St. Louis, Mo., rein.-con., tile frame bldgs., St. Clair Co., to Hauer Bros. Constr. Co., 424 Lebanon Ave., Belleville. Bids 9/30.

★†**Ill., Seneca**—Pub. Housing Auth., NHA, 201 N. Wells St., Chicago, Ill., 500 prefabricated temporary row houses, Ill. 11165 and 96 dormitory apartments, Ill. 11166, to Selzer Ornst Co., 6222 West State St., Milwaukee, Wis., **$1,560,141.** CD 10/14—ENR 9/17.

†**Louisiana**—Industrial Company, bldgs., to Chris Larsen Co., Maritime Bldg., New Orleans. Federally financed.

†**Louisiana**—U. S. Eng., foot Prytania St. New Orleans, addnl. housing, Inv. 43-126, to Rabalais & Murphy, 212 S. 14 St., Baton Rouge. Awarded 10/8.

†**Louisiana**—U. S. Eng., foot Prytania St., New Orleans, bldgs., Inv. 1096-43-135, to Gravier & Harper, Alexandria. Awarded 10/8.

†**Louisiana**—U. S. Eng. U. S. Post Office & Courthouse, Vicksburg, Miss., bldgs., utilities, Grant Parish, to James Ansell Harper, Crowville, **$100,000-$500,000.** Awarded 10/14.

†**Louisiana**—U. S. Eng., foot of Prytania St., New Orleans, bldgs., to Rabelais & Murphy, Bunkie. Awarded 10/13.

†**Louisiana**—U. S. Eng., foot of Prytania St., New Orleans, bldg., Inv. 43-136, to R. P. Farnsworth & Co., 1515 S. Salcedo St., New Orleans. Awarded 10/12.

★†**Maryland**—U. S. Eng., 1 and Douglas Sts., N.W., Wash., D. C., bldg., Montgomery Co.,

PUBLIC BLDGS. (Contracts Awarded, Cont'd.)

to Ross Engineering Co., 3308 14 St. N.W., Wash., D. C. Est. over $500,000.

★†Maryland—U. S. Eng., 1 and Douglas Sts., N.W., Wash., D. C., bldg., Anne Arundel Co., to Colwill & Tovell, 2114 Maryland Ave., Baltimore. Bids 10/12.

★†Maryland—U. S. Eng., Aberdeen, bldg., Harford Co., to A. A. Lutz, 50 E. 42 St., New York, N. Y., $500,000-$1,000,000.

†Massachusetts—U. S. Eng., Park Square Bldg., Boston, temporary frame bldgs., No. 175-43-NEG 84, Barnstable Co., to M. Slotnick, 233 Washington St., Boston. Est. $1000,000-$500,000. Bids 10/12.

†Massachusetts—U. S. Eng., Park Square Bldg., Boston, bldg., pile fdns., Suffolk Co., to Aberthaw Co., 80 Federal St., Boston; electrical work to M. B. Foster Electric Co. 368 Congress St., Boston. Est. over $150,000.

†Michigan—U. S. Eng., 700 Union Guardian Bldg., Detroit, bldg., Alpena Co., to Spence Bros., Saginaw, under $1,000,000.

★†Michigan—U. S. Eng., 700 Union Guardian Bldg., Detroit, bldgs., covered walks, installing sprinkler and steam distr sys., Wayne Co., to Brown & Matthews, Inc., 5117 General Motors Bldg., Detroit, less than $1,000,000.

★†Nebraska—U. S. Eng., 1709 Jackson St., Omaha, bldgs., to E. W. Niles, Fort Crook, over $1,000,000. CD 8/12—ENR 8/20.

Nev., Las Vegas—Comrs. Clark Co., health dpt. quarters, Clark County Court House grounds, to S. C. Rasmussen, 324 N. 6 St.

†New Jersey—U. S. Eng., 120 Wall St., New York, N. Y., bldg., Middlesex Co., to Gumina Building & Constr. Co., 14 Georges Rd., New Brunswick, under $50,000.

†New Jersey—U. S. Eng., 6 and Walnut Sts., Phila., Pa., frame bldgs., Monmouth Co., to Hansen-Jensen, Inc., 337 N. Broad St., Elizabeth, $50,000-$100,000.

†New Mexico—U. S. Eng., Albuquerque, military housing, incinerator plant, Lea Co., to H. W. Balay, 607 S. Solano St., Albuquerque, $100,000-$500,000. Bids 9/18. CD 9/10—ENR 9/17.

★†New Mexico—U. S. Eng., bldgs., Eddy Co., to E. S. McKittrick & Co., Inc., La Gaverna Hotel, Carlsbad, $500,000-$1,000,000. Bids about 10/5. CD 9/25.

★†Ohio—U. S. Eng., 700 Union Guardian Bldg., Detroit, Mich., bldgs., Allen Co., to Herber & Green, 3201 S. Lafayette St., Fort Wayne, Ind., less than $1,000,000.

★†Oklahoma—U. S. Eng., 416 Wright Bldg., Tulsa, bldgs., Mayes Co., to Long Constr. Co., Philtower Bldg., Tulsa.

★†Oklahoma—U. S. Eng., 416 Wright Bldg., Tulsa, bldgs., grading, utilities, roads, streets, Kay Co., to Olson, Assenmacher & Rokahr, 410 S. 7 St., Lincoln, Neb. Est. over $1,000,000. CD 10/7—ENR 10/15.

†Oklahoma—U. S. Eng., 231 W. Main St., Denison, Tex., bldg., Grady Co., to R. N. Hancock, 102 Heights Blvd., Houston. Est. under $50,000.

†Oklahoma—U. S. Eng., Fort Sill, cold storage bldg., facilities, Comanche Co., to Bowers & Lundgren, Topeka, Kan., $100,000-$500,000. CD 10/6—ENR 10/8.

★†Oregon—U. S. Eng., Pittock Blk., Portland, bldgs., roads, utilities, Inv. 698-275, Jefferson Co., to W. C. Smith, 216 Bd. Trade Bldg. and Kuckenberg Constr. Co., 11104 N.E. Holman St., both Portland. $500,000-$1,000,000. Bids 9/28, awarded 10/12.

★†Pennsylvania—Defense Plant Corp., 811 Vermont Ave. N.W., Wash., D.C., reconstructing bldg., to Heller Murray Co., 222 W. Rayen Ave., Youngstown, O., over $1,000,000. Industrial Company will operate. CD 8/24—ENR 8/27 under Industrial Bldgs.

†Rhode Island—U. S. Eng., 819 Industrial Trust Bldg., Providence, housing, No. 699-43-83, Washington Co., to E. Turgeon, 614 Turks Head Bldg., Providence. Est. $100,000-$500,000. Bids 10/14. CD 10/9.

†Rhode Island—U. S. Eng., 819 Industrial Trust Bldg., Providence, bldg., No. 699-43-78, Newport Co., to Argentieri Constr. Co. Inc., 49 Weybosset St., Providence. Est. $50,000. Bids 10/9. CD 10/6—ENR 10/8.

†South Carolina—U. S. Eng., Florence, bldgs., utilities, Florence Co., to H. S. B and F-J Const. Co., Conover.

★†Texas—U. S. Eng., Fort Sam Houston, addnl. bldgs., Spec. 42-408, Taylor Co., to L. L. McCandless, 1809 Riverview St., Austin, $500,000-$1,000,000. CD 10/2—ENR 10/8, under LB.

†Texas—U. S. Eng., 231 W. Main St., Denison, miscellaneous bldgs., Solic. 257-43-59, Bowie Co., to Dallas Foundation Co., Inc., 2602 Canton St., Dallas, $100,000-$500,000. Awarded 10/15.

†Texas—U. S. Eng., Fort Sam Houston, bldgs., Spec. 42-449, Matagorda Co., to L. Vernon Miller, 727 1st Natl. Bank Bldg., Hous-

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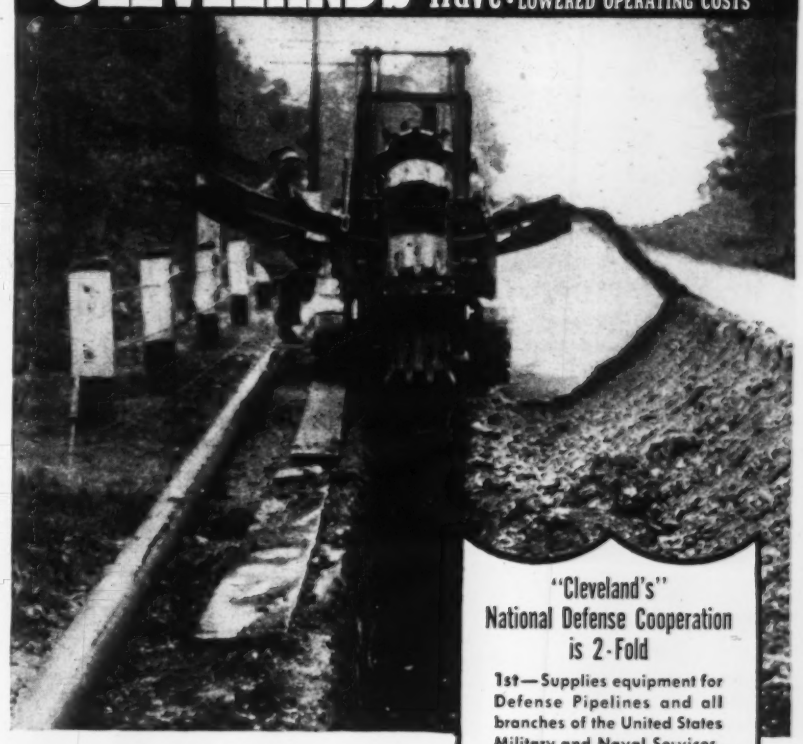

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PUBLIC BLDGS. (Contracts Awarded, Cont'd.)

ton, est. **$100,000-$500,000.** Bids about 10/5, awarded 10/14. CD 9/29—ENR 10/1.

†**Texas**—U. S. Eng., Fort Sam Houston, bldg. unit, Spec. 42-435, Bexar Co. to Alamo Constr. Co., Smith-Young Tower, San Antonio. **$100,000-$500,000.** Bids about 10/7. CD 10/2.

†**Texas.**—U. S. Eng., Fort Sam Houston, bldgs., wing addns., revising electric distr. sys., new parking area, Spec. 42-448, to Alamo Constr. Co., Smith-Young Tower, San Antonio, **$50,000-$100,000.** Bids 10/3. CD 9/29.

★†**Texas**—U. S. Eng., 231 W. Main St., Denison, power house for Denison Dam and Reservoir, Red River, Grayson Co., to C. F. Lytle Co., Denison, **$1,000,000-$5,000,000.** Bids 10/6. CD 9/29—ENR 8/27.

★†**Texas**—Defense Plant Corp., 811 Vermont Ave. N.W., Wash., D. C., plant, railway tracks, to Arthur G. McKee & Co., 2300 Chester St., Cleveland, O. and Central Engineering & Constr. Co., Cleveland, O. Est. **$3,000,000.** Industrial Company will operate.

★†**Texas**—U. S. Eng., Fort Sam Houston, housing motor fuel facilities, Spec. 42-502, Bastrop Co., to C. L. Browning, Jr., 812 Insurance Bldg., San Antonio, over **$500,000.** CD 10/13—ENR 10/15, under LB.

★†**Texas**—Industrial Company, plant, to Winston Bros., Haglin Constr. Co., Missouri Valley Bridge & Iron Co. and Sollitt Constr. Co., Port Neches, approx. **$10,000,000.** Federally financed. Awarded 10/13.

†**Texas**—U. S. Eng., 231 W. Main St., Denison, frame housing, Solic. 257-43-89, Bowie Co., to Owens Constr. Co., 2663-5 Ave., Fort Worth, **$100,000-$500,000.**

†**Texas** and **Oklahoma**—U. S. Eng., 231 W. Main St., Denison, Tex., cold storage facilities, to R. N. Hancock, 102 Heights Blvd., Houston, Tex., and Campbell & Kay, Tyler, Tex., **$100,000-$500,000.**

†**Wisconsin**—U. S. Eng., 408 Federal Bldg., Milwaukee, bldgs., to R. H. Becker, Elm Grove.

†**Wyoming**—Defense Plant Corp., 811 Vermont Ave. N.W., Wash., D. C., general contract bldg., to General Constr. Co., and J. Walter Johnson, 5205 Hollywood Blvd., both Los Angeles, Calif.; electrical work, to Yellowstone Electric Co., Billings, Mont. Est. **$50,000-$100,000.** Industrial Company will operate.

★†**Alaska**—Pub. Housing Auth., NHA, Skinner Bldg., Seattle, Wash., permanent housing units, Projects 50051 and 50013, to C. W. Hufeisen, Anchorage, **$150,000** and **$400,000** respectively. CD 9/15—ENR 9/17.

COMMERCIAL BUILDINGS

PROPOSED WORK

N. J., West Belmar (mail Belmar)—Roosevelt Park, Inc., 2 and Lafayette Aves., Raritan, forty 1½ story, bsmnt. residences. $188,000.

Pennsylvania—Enfield Housing Corp., Springfield Twp., forty-five 2 story masonry, frame dwellings, Enfield Tract, Springfield Twp. Over $200,000.

★**Wis., Milwaukee** — Marquette University, Rev. R. N. Hamilton, dean, 615 N. 11 St., library. $1,000,000.

BIDS ASKED

Bids Asked October 28

Pa., Upland—Upland Development, Upland, 2 story, concrete block housing units in blocks of 2, 4 and 6 units, total 100 units. Gleeson & Mulrooney, Fox Bldg., Phila., archts.

CONTRACTS AWARDED

Calif., Hayward — Cox Building Co., 25188 Niles Rd., ninety-four 1 story frame residences, Hayward Heights, Owner builds. **$376,000.** CD 10/2—ENR 10/8.

Calif., Los Angeles (Venice Dist.)—Geo. E. Melton, 9401 Sepulveda Blvd., 46 frame dwellings, 9300, 9400 and 9500 Blocks of El Manor St. Owner builds. **$150,000.**

Calif., San Leandro—Clyde Alexander, 1622 E. 14 St., 1 story 8 room duplexes, housing, Bristol Blvd. Owner builds. Over **$150,000.**

Conn., Milford—Beltrose Housing Corp., Easton, forty-seven 24x29 ft. frame houses. Owner builds. **$150,000.**

Me., Portland — MacArthur Gardens, c/o contractor, fifty-eight 2 story brick homes, Eastern Promenade, Montreal and Walnut Sts., to Walnut Constr. Co., 302 Eastern Promenade. Est. **$260,000.** S. H. Morris, 134 N. LaSalle St., Chicago, Ill., archt.

Mass., Melrose—P. Drinkwater, 56 School St., 8 story, 26x34 ft. homes. Owner builds. Est. **$450,000.**

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MAHON

N. J., Bound Brook — Highgate Estates, Inc., 27 Cedar St., New York, N. Y., one hundred 2 story, bsmnt., frame residences, to Chas. Decter, 189 Hobson St., Newark, **$325,000.** L. M. Steuber, 423 Amherst St. E., Orange, archt.

O., Cleveland—Peter Sepper, Jr., 17504 Naragansett Ave., Lakewood, 30 frame houses. Owner builds. **$150,000.**

R. I., Quonset Point — Cedarhurst Farms, Inc., N. B. Smith, Camp Ave., North Kingston, 100 frame homes, to Schweers & Smith, Inc., 5 E. 44 St., New York, N. Y. Est. over **$150,000.** A. B. Mills, 1822 I St. N.W., Wash., D. C., archt.

Wash., Seattle—C. F. Bishop, 3849 34 Ave. W., twenty-four 1 story, bsmnt., 30x32 ft. duplex dwellings, day labor. **$168,000.**

Wis., Milwaukee—Lowenbach Land & Building Co., c/o contractor, ten 1 story, 23x27 ft. frame residences, concrete block fdn., to Anderson Bros. Building Co., 8020 W. Becher St., electrical contract, to Ladwig Electric Co., 1229 N. 19 St.

Wis., West Bend (br. Milwaukee)—Arnold Bldg. Co., 1018 E. State St., Milwaukee, ten 1 story, 25x28 ft. frame residences, block fdn., owner builds, electrical contract, to L. J. Schubert, Slinger.

INDUSTRIAL BUILDINGS

PROPOSED WORK

★**Wash., Benton**—FOUNDRY—Pacific Can & Foundry Co., Benton, foundry. Est. complete $3,000,000. O. D. Conver, 1740 E. 12 St., Cleveland, O., engr.

BIDS ASKED

†**Texas** — PLANT — Steinman & Goleman, archts., Liberty Bldg., Beaumont, altering bldg., for Industrial Company.

Tex., Sweeney—PLANT—J. F. Pritchard, engr., Sweeney, bldgs. for refinery area, for J. S. Abercrombie Co., Gulf Bldg., Houston. $150,000. CD 8/20—ENR 8/27.

LOW BIDDERS

Calif., San Francisco—MACHINE SHOP—General Eng. & Dry Dock Co., Filbert and Sansome Sts., 1 story, 150x155 ft., rein.-con. machine shop, from Carrico & Gautier, 365 Ocean Ave., **$158,161.** C. F. Gromme, Alberts Bldg., San Rafael, archt. H. M. Engle, 116 Sutter St., engr. CD 10/15.

INDUSTRIAL BLDGS. (Contracts Awarded, Cont'd.)

Calif., Torrance—MACHINE SHOP—National Supply Co., 1542 Border Ave., Oct. 8, 218x240 ft. frame, **cement machine shop**, from C. L. Peck, Inc., 223 I. W. Hellman Bldg., Los Angeles. Est. over **$40,000.** Taylor & Taylor, 539 N. 3 St., Los Angeles, archt and engr.

CONTRACTS AWARDED

Calif., San Francisco—TANNERY—Metten & Gebhardt, 1775 Egbert St., rebuilding portion 2 story, 90x350 ft. tannery, to Fred J. Early, Jr., 369 Pine St., San Francisco. CD 10/2—ENR 10/8.

Conn., North Haven—FACTORY—Atlas-Ansonia Co., 54 Grant St., twenty 1 story, 20x20 ft. factory extens., separate contracts. **$40,000.** CD 10/14—ENR 10/22.

Ia., Boone—POWER HOUSE—Iowa Electric Light & Power Co., Boone, steel, concrete, brick power house, to Lippert Bros., Boone. Est. **$250,000.**

Ill., Rockford—FACTORY—Rockford Drop Forge Co., 2031 9 St., factory addn., to Linden & Sons, Inc., 1102 10 St., **$40,000.** G. A. Johnson, Swedish American Bank Bldg., archt.

Ill., Rockford—FACTORY—Sundstrand Machine Tool Co., 2531 11 St., factory addn., to Linden & Sons, 1102 10 St., **$41,000.** G. A. Johnson, Swedish-American Bank Bldg., archt.

Ky., Louisville—FACTORY—Owner, c/o contractor, brick, concrete steel plant, to Struck Constr. Co., P. O. Box 7, Highland Park Station, Louisville. Est. approx. **$150,000.** Albert Kahn Associate Architects & Engineers, Inc., New Center Bldg., Detroit, Mich., engrs. and archts.

Mass., Lynn—BOILER PLANT—Lynn Gas & Electric Co., 90 Exchange St., brick, concrete boiler plant addn., Broad St., to Walsh Bros., 159 Hampshire St., Cambridge. Est. over **$40,000.** Stone & Webster, Inc., 49 Federal St., Boston, engrs.

Minn., Osseo—PLANT—Farm Valley Foods, Inc., H. G. Hornibrook, pres., 100 17 Ave. N., Minneapolis, general contract 1 story, bsmnt., 60x275 ft. concrete block potato dehydrating plant and sewage disposal sys., to Einar Bergman, St. Cloud, cost plus basis. To exceed **$40,000.** A. Neyer, 282 Baker Bldg., Minneapolis, consult. engr.

Mo., St. Louis—FACTORY—Alligator Co., 4171 Bingham Ave., 3 brick, rein.-con. factory addns., to Murch-Jarvis Co., Cotton Belt Bldg., 406 Pine St. Est. over **$50,000** with equip. A. C. Maack, Cotton Belt Bldg., archt.

Neb., Alliance—ROUNDHOUSE, etc.—Chicago, Burlington & Quincy R.R. Co., F. T. Darrow, ch. engr., 547 W. Jackson Blvd., Chicago, Ill., brick addns. roundhouse and shops, to Olson, Assenmacher & Rokahr, 410 S. 7 St., Lincoln. Est. **$100,000.**

Nev., Toy (mail Lovelock)—MILL—United Tungsten Mines, Ltd., F. D. Le Mon, pres., 139 N. Virginia St., Reno, mill. Owner builds.

N. J., Passaic—MILL—Forstmann Woolen Co., 2 Barbour Ave., 2 story, brick mill addn., to Edward Reihl Co., 85 Delaware Ave., Paterson, **$40,000.**

N. J., Summit—PLANT—A. Zhodiakin Engineering Co., 250 W. 54 St., New York, N. Y., 2 story, brick, concrete block plant, to James F. Mitchell, Inc., 40 Clinton St., Newark, **$50,000.** R. Calabrese, 65 Taylor St., Newark, archt. CD 7/22—ENR 7/20.

O., Cleveland—FACTORY—Valley Mold & Iron Corp., H. Rumage pres., Hubbard, removing ladle, hot metal, casting, ramming, sand and finishing bldgs., from Hubbard to Cleveland, and new railroad siding, to National Eng. & Contg. Co., E. 4 St. and Central Ave. CD 8/3—ENR 8/6.

Tenn., Memphis—SHOPS, etc.—Illinois Central System, C. H. Mottier, ch. engr., 135 E. 11 Pl., Chicago, Ill., shops, inbound freight house, mail terminal, etc., to Ellington-Miller Co., 25 E. Jackson St., Chicago, Ill. **$200,000,** cost plus.

Wis., Clintonville—WAREHOUSE—Clintonville Canning Co., 1 story, 44x80 ft., brick warehouse, concrete fdn., to Lemke & Felts, Shawano. J. F. Dreger, 138 Waugoo St., Oshkosh, archt.

Wis., Milwaukee — FACTORY, etc. — Cuneo Press, Inc., 247 E. Chicago Ave., 2 story, 80x150 ft., brick factory and office addn., concrete fdn., to Peters Constr. Co., 2901 N. 28 St.

Wis., Oshkosh—FACTORY—H. A. Thorndike, 615 Jackson Dr., remodeling 2 story, 150x180 ft., brick, factory, to A. W. Jeske, 265 Oak St.

Wis., West Bend (br. Milwaukee)—WAREHOUSE—Carl Pick Mfg. Co., West Bend, 1 story, 28x165 ft. brick, warehouse addn., concrete fdn., to Berend & Kremoreiter, 177 Division St.; electrical work by owner.

Wis., West Bend (br. Milwaukee)—LAUNDRY—E. E. De Toncq, 235 5 Ave., 2 story, 39x40 ft. concrete, brick laundry addn., to Ben Tennies, 242 Edgewood Lane; electrical contract, to Raquet Electric Co., West Bend. J. P. Brucker, 2865 N. Lake Dr., Milwaukee, archt.

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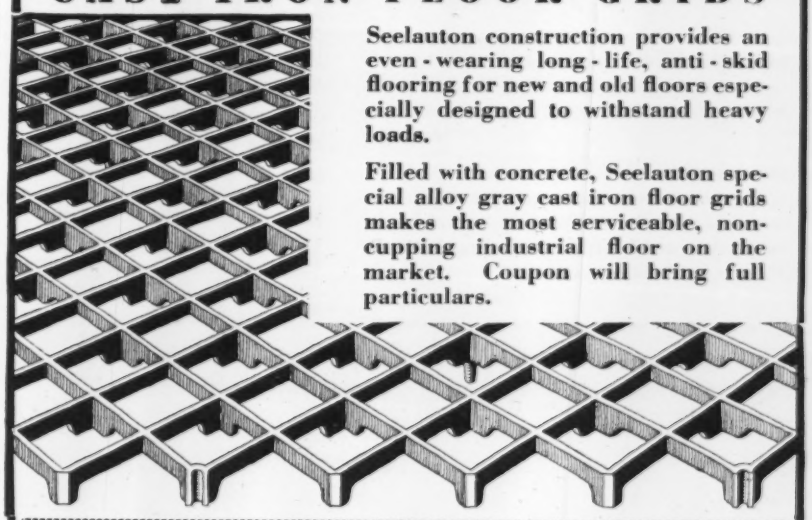

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E.N.R.

NEW ADVERTISEMENTS received by October 30th appear in November 5th issue subject to limitations of space available

POSITIONS VACANT

These Positions Vacant advertisements are published subject to agreement by the advertisers not to consider applicants now employed on war work unless they obtain written release from present employer.

WANTED—Graduate Civil Engineers—preferably with from two to five years general experience—as field engineers in connection with Water Waste Surveys, Distribution Studies and Trunk Main Surveys of Municipal Water Distribution Systems. The Pitometer Company, Inc., #50 Church Street, New York City, N. Y.

SALES ENGINEERS for structural steel fabricator to operate out of New York, Pittsburgh or Washington offices. Only those need apply who have extensive contacts contiguous to one or more of the locations mentioned. Submit full data with application, including salary required and snapshot. P-112, Engineering News-Record, 330 W. 42nd St., New York, N. Y

ESTIMATOR, for general contractor on government work, best only, one with engineering and architectural experience preferred. Give details. P. O. Box 129, Mobile, Ala.

WANTED IMMEDIATELY—Junior Civil Engineer. Airport experience desirable, but not essential. Give full details on educational background, experience record, salary expected, draft status and when available. Enclose photograph. Location, Maryland. P-119, Engineering News-Record, 330 W. 42nd St., New York, N. Y.

HEATING AND PLUMBING Estimator and take-off man—Contact Mechanical Division, Virginia Engineering Co., Inc., Naval Air Station, Norfolk, Virginia.

WE NEED IMMEDIATELY experienced Electrical Engineers. Airport experience desirable but not essential. Give full details of experience and recent earnings in first letter. Also citizenship and draft status. Gannett, Eastman & Fleming, Inc., P. O. Box 209, Upper Marlboro, Maryland.

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EXECUTIVES AND TECHNICAL MEN. Qualified candidates desiring $2,000 to $20,000 positions may contact employers through our confidential services. Established 27 years. The National Business Bourse, 20 W. Jackson Blvd., Chicago.

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POSITIONS WANTED

GENERAL MANAGER, electrical construction, available immediately. Also engineer, 20 years experience. Can handle large crews for all types electrical work. Just completed large shell-loading plant. Very familiar with Government procedure. Married. Age 42. Electrical Engineering graduate. PW-55, Engineering News-Record, 520 N. Michigan Ave., Chicago, Ill

CIVIL ENGINEER; Graduate; 33 years experience; design, construction; Industrial plants; Water supply; Hydro-electric developments. PW-36, Engineering News-Record, 330 W. 42nd St., New York, N. Y.

CONSTRUCTION SUPERINTENDENT and Engineer: Age 33, Sewers, water, domestic gas, process piping, welded pipe-lines, roads, disposal, contonment buildings. Can Supervise, Estimate, Design; competent with contracts and writing of Specifications. PW-58, Engineering News-Record, 330 W. 42nd St., New York, N. Y.

GENERAL BUILDING Construction Superintendent or manager experience covers 30 years on all kinds of structures. Projects costing up to 10 Million Dollars. Also defense Housing cantonments, and industrial structures. PW-114, Engineering News-Record, 330 W. 42nd St., New York, N. Y.

WANTED
Refinery Design Engineer

Regular position for man with thorough knowledge of pressure vessel and piping design. Experience as chief draftsman and construction engineer is desirable. Location middle west. Medium size independent oil company. In reply please specify personal data, experience, draft status and salary required.

P-109, Engineering News-Record
520 No. Michigan Ave., Chicago, Ill.

WANTED
ELECTRICAL ENGINEER

To estimate—Must be familiar with distribution system. Experience in other electrical fields desirable. Must be capable of supervising field office. Permanent position.

P-108, Engineering News-Record
330 W. 42nd St., New York City

POSITIONS WANTED

CONSTRUCTION SUPERINTENDENT available at once. Extensive experience Docks, Buildings, Railroads, Highway and Grade Separation. Recent experience Navy and Army projects. P. Weiland, 15 E. 196 St., N. Y. City.

ESTIMATOR, quantity surveyor, cost engineer and purchasing agent, 25 years experience in the building industry. Eleven years experience as head of construction company. Thorough knowledge of current material prices and labor costs throughout the country. Experience in Government, Municipal and private, industrial and housing projects. Now in my seventh year as cost engineer with government agency. Exempt from Army service, in perfect health. Available at short notice. PW-82, Engineering News-Record, 330 W. 42nd St., New York City.

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CONSTRUCTION SUPERINTENDENT also Graduate Engineer. Age 45, twenty years experience on Housing Projects, water mains, Sewers, Tunnels, Heavy Excavations, Dirt Moving, Concrete, Caissons, Piling, Roads, Dams, available October 1st. PW-97, Engineering News-Record, 520 N. Michigan Ave., Chicago, Ill.

CIVIL STRUCTURAL ENGINEER, twenty-five years experience in steel construction. Engineering, fabrication and construction. Successfully filled jobs as Chief Engineer and Manager for Structural Fabricators. Licensed in in Ohio. Age 57. PW-103, Engineering News-Record, 520 N. Michigan Ave., Chicago, Ill.

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GENERAL CONTRACTORS SUPERINTENDENT. Age 43. Graduate Civil Engineer. Completing large defense airport, grading, drainage and paving. Available about December first; also several assistant superintendents and engineers. Prefer middle west or south. PW-115, Engineering News-Record, 520 N. Michigan Ave., Chicago, Ill.

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ESTIMATOR and cost analyst engineer. General building construction. Experience in office and field, purchasing and functions of general contractors office. Draft exempt. PW-122, Engineering News-Record, 330 W. 42nd St., New York, N. Y.

SUPERINTENDENT OR FOREMAN, 10 years experience, all classes of work, Sewer, Water, Foundations, Cofferdams, Piling, Concrete work, Clearing, Grading. Good Pusher, American Citizen. References, Available Immediately. PW-123, Engineering News-Record, 520 N. Michigan Ave., Chicago, Ill.

EXPLOSIVE AND DRILL Engineer. Licensed 20 years Experience, Highest References, Age 46. Rock and Concrete Demolition. Know all Pneumatic Equipment. Now available. Address Box 4009, Station-H, Columbus, Ohio.

CIVIL AND CONSTRUCTION Engineer—available for engagement with contractor, engineer, industrial concern as manager or assistant, resident or works engineer, supervisor-experienced in utilities, housing, mechanical trades; licensed. Prefer midwest; aged 43, status 3A. Address PW-125, Engineering News-Record, 520 N. Michigan Ave., Chicago, Ill.

CIVIL ENGINEER, 8 years experience, Contractors Engineer, Estimator, Superintendent-Building and Engineering construction. Go anywhere. Registered Professional Engineer. PW-126, Engineering News-Record, 520 N. Michigan Ave., Chicago, Ill.

STRUCTURAL DESIGN ENGINEER. Graduate C.E. Age 40. 18 years experience design and detail in steel, concrete or timber structures. Shipways, Piers, Docks, Quay and Retaining Walls, Heavy Foundations, Industrial and Commercial Buildings, Hotels and Office Buildings. Capable of taking charge of all design work, as well as the execution of all structural plans and specifications for a complete project. Available November 1st. PW-128, Engineering News-Record, 330 W. 42nd St., New York, N. Y.

MANAGER, General Superintendent, Chief Engineer—graduate Civil Engineer licensed. General large scale construction most all lines. Last connection large government project for one of the best known concerns. Familiar with both design and construction. Experience of over 25 years has included also responsible charge foreign tropical work. PW-129, Engineering News-Record, 330 W. 42nd St., New York, N. Y.

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ENGINEERING DESIGNER—Draftsman desires position. Experienced in wood, steel, and concrete. College graduate, ten years engineering experience. Last salary $80 week. PW-132, Engineering News-Record, 330 W. 42nd St., New York, N. Y.

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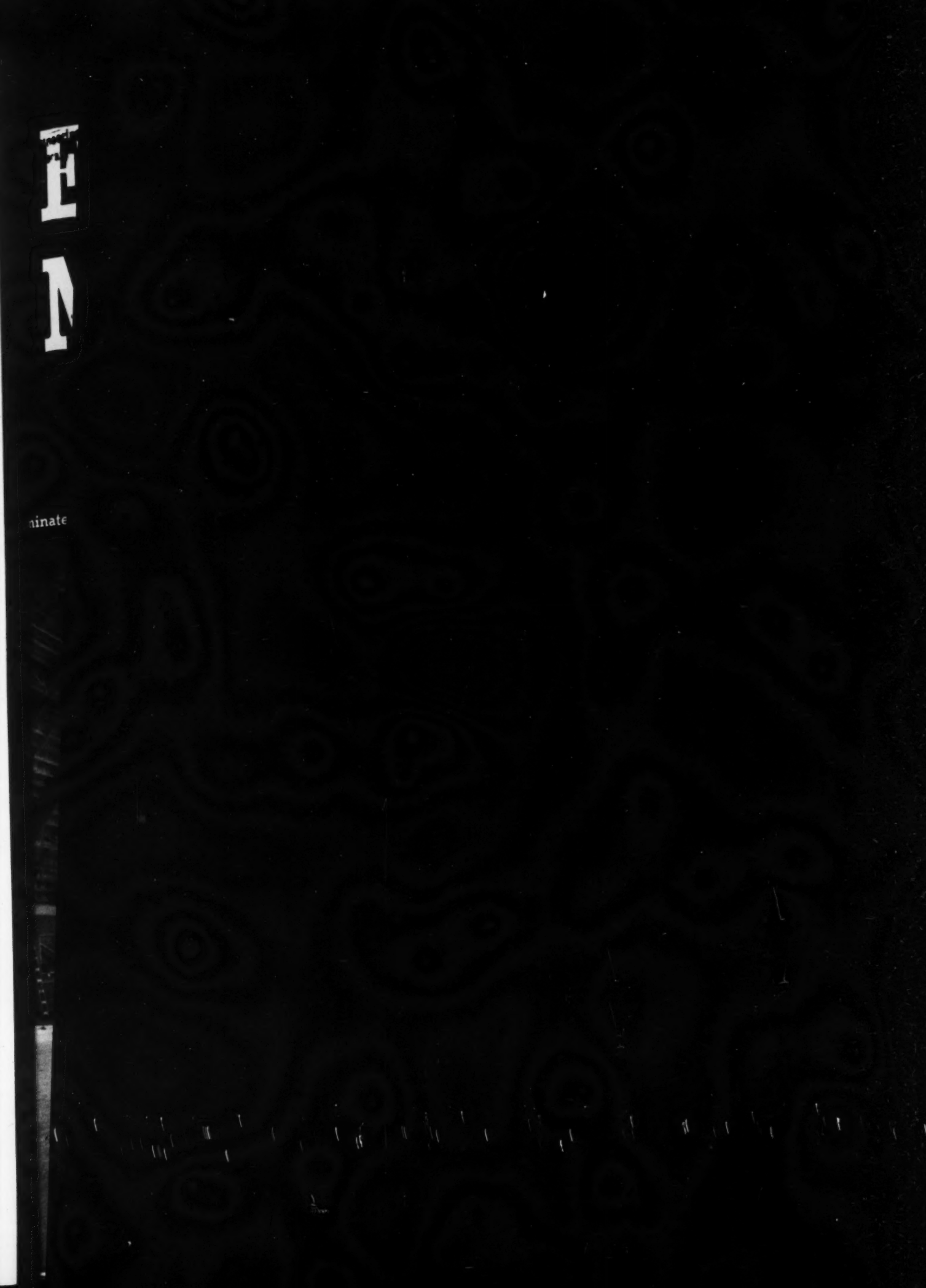
CONSTRUCTION EXECUTIVE, Superintendent of Field Operations, Buildings, Water Works, etc. Long and varied experience in construction field. Available Immediately. PW-134, Engineering News-Record, 330 W. 42nd St., New York, N. Y.

(Continued on opposite page)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